ENSURING AVIATION SAFETY IN THE ERA OF UNMANNED AIRCRAFT SYSTEMS

(114–28)

HEARING

BEFORE THE

SUBCOMMITTEE ON
AVIATION

OF THE

COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

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Washington, DC 20515

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Ranking Member

Christopher P. Bertram, Staff Director

Katherine W. Dedrick, Democratic Staff Director

October 5, 2015

SUMMARY OF SUBJECT MATTER

TO:	Members, Subcommittee on Aviation
FROM:	Staff, Subcommittee on Aviation
RE:	Subcommittee Hearing on "Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems"

PURPOSE

The Subcommittee on Aviation will meet on Wednesday, October 7, 2015 at 10:00 a.m. in 2167 Rayburn House Office Building to explore issues related to aviation safety as the number of unmanned aircraft systems (UAS) increases in the United States. The Subcommittee will receive testimony from the Federal Aviation Administration (FAA), the United States Forest Service, the Academy of Model Aeronautics (AMA), the Air Line Pilots Association (ALPA) and a Professor of Aeronautics and Astronautics.

BACKGROUND

Overview

UAS have been a part of American aviation for nearly a century, primarily in military research and operations.[1] The FAA first authorized UAS operations in U.S. airspace in 1990.[2] Most operations since that time have been confined to public uses such as law enforcement and scientific research.

Recent and rapid advancements in computing technology have transformed UAS. Small unmanned aircraft are typically substantially less expensive, easier to acquire and simpler to

[1] John David Blom, *Unmanned Aerial Systems: A Historical Perspective*, Occasional Paper 37, pp 46. Combat Studies Institute Press, US Army Combined Arms Center. Available at: http://usacac.army.mil/cac2/cgsc/carl/download/csipubs/OP37.pdf

[2] http://www.faa.gov/uas/faq/media/1009_UAS_Fact_Sheet.pdf

operate than manned aircraft.[3] In some cases, UAS offer capabilities that cannot be matched by manned aircraft such as close inspections of oil rig flare stacks and transportation infrastructure.

As a result, there is tremendous demand for UAS as new applications are developed across industries beyond aviation including agriculture, energy and media. The economic opportunities and impacts are expected to be substantial. The Association of Unmanned Vehicle Systems International foresees that the use of UAS will lead to the creation of 100,000 jobs and $82 billion in economic impact by 2025.[4]

Governing law and regulation

In the *FAA Modernization and Reform Act of 2012* (P.L.112-95), Congress directs the FAA to take steps in furtherance of UAS integration into the National Airspace System.[5] This legislation directs the FAA to create a comprehensive plan for the integration of civil UAS by September 2015 and to issue regulations applicable to the operation of small UAS.[6] The FAA published a proposed rule for the Operation and Certification of Small UAS in February 2015, and reports that the final rule will be completed sometime in 2016.

Section 333 of the same legislation directs the FAA to permit UAS operations meeting certain criteria prior to the completion of the required comprehensive plan and rulemaking. After some delay, the FAA began permitting operations under section 333 in November 2014 for a variety of commercial applications, including surveying, photography and pipeline inspection. As of September 24, 2015, the FAA had granted 1,732 permits under section 333.

Section 336 defines "model aircraft" as any unmanned aircraft that are capable of sustained flight, flown within visual line of sight of the person operating the aircraft, and flown for hobby or recreational purposes. Section 336 prohibits FAA from issuing any rule or regulation regarding model aircraft, provided:

1. the aircraft is operated in accordance with a community based set of safety guidelines and within the programming of a nationwide community-based organization;
2. the aircraft is limited to less than 55 pounds unless otherwise certified;
3. the aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft; and
4. notice is given to an airport operator or airport air traffic control tower if flown within 5 miles of an airport.

If an operator of an unlawful UAS operation is identified, the FAA and other agencies can pursue civil penalties for careless and reckless operations or criminal penalties for other legal

[3] Small unmanned aircraft are those weighing less than 55 pounds.
[4] The Economic Impact of Unmanned Aircraft Systems in the United States, AUVSI, Mar. 2013. See: http://www.auvsi.org/auvsiresources/economicreport
[5] Pub. L. 112-95, 126 Stat 11. (Feb. 14, 2012)
[6] *Id.at* 126 Stat. 73, Sec. 332

violations.[7] To date, the FAA has initiated 20 legal enforcement actions related to unlawful UAS operations. The FAA is also working with state and local law enforcement agencies to address unlawful UAS operations.[8]

National Airspace System Safety

The proliferation of UAS in the United States has occurred at a dramatic rate, particularly as they have become widely available in the consumer market. In 2010, the FAA estimated that 15,000 UAS would be in operation by 2020.[9] Today, it appears sales of UAS exceed 15,000 each month and up to one million units may be sold during the 2015 holiday season.[10] The available data does not distinguish between those that will be purchased or sold as "model aircraft" used by hobbyists or other UAS used for personal or commercial purposes.

The rapid growth in unmanned aircraft (recreational, commercial and public) operated in the United States has been accompanied by a sharp rise in reported sightings by pilots of manned aircraft and air traffic controllers. Since last year, these sightings have been reported as occurring in proximity to major airports and during critical phases of flight.[11] The trend has continued into 2015 as pilots continue to report sightings to the FAA.[12] In August 2015, in response to a Freedom of Information Act request, the FAA released a compilation of over seven hundred reported sightings of UAS by pilots between November 2014 and early-August 2015. In addition, efforts to combat forest fires have been seriously disrupted as tanker crews have been forced to cancel or postpone missions because of unmanned aircraft sightings[13] In 2015, the U.S. Forest Service reported 18 unauthorized unmanned aircraft incursions above or near wildfires; 10 of these events hampered the Forest Service's aviation operations.[14] In the majority of cases,

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[7] *See* 49 U.S.C. §§ 44709, 46301. In addition, chapter 463 of title 49 authorizes fines and/or imprisonment under title 18 for violations of national defense airspace, interference with air navigation, and transportation of hazardous materials. 49 U.S.C. §§ 46307-46317.

[8] FAA Issues UAS Guidance for Law Enforcement (Jan. 2, 2015) *available at* https://www.faa.gov/news/updates/?newsId=81244.

[9] Fed. Aviation Admin. *FAA Aerospace Forecast Fiscal Years 2010-2030, Unmanned Aircraft Systems,* available at: https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/2010%20Forecast%20Doc.pdf Pg. 48.

[10] *Unmanned aerial vehicles, Welcome to the Drone Age,* The Economist, Sept. 26, 2015. & Aaron Karp. *FAA warns of 'a million drones under people's Christmas trees',* Air Transport World, Sept. 28, 2015. Available at: http://atwonline.com/technology/faa-warns-million-drones-under-people-s-christmas-trees

[11] Craig Whitlock. *Near-collisions between drones, airliners surge, new FAA reports show*, Wash. Post, Nov.26, 2014. https://www.washingtonpost.com/world/national-security/near-collisions-between-drones-airliners-surge-new-faa-reports-show/2014/11/26/9a8c1716-758c-11e4-bd1b-03009bd3e984_story.html

[12] Craig Whitlock. *FAA records detail hundreds of close calls between airplanes and drones,* Wash. Post. Aug. 20, 2015. https://www.washingtonpost.com/world/national-security/faa-records-detail-hundreds-of-close-calls-between-airplanes-and-drones/2015/08/20/5ef812ae-4737-11e5-846d-02792f854297_story.html

[13] Joseph Serna, *Drone sighting halts some firefighting efforts in Northern California*, Los Angeles Times, Sept. 14, 2015.

[14] Information provided to Subcommittee staff

authorities have been unable to ascertain the identity of the unmanned aircraft operators. In addition to reports by pilots, unmanned aircraft have posed safety risks on the ground. In the last year, unmanned aircraft have crashed into the White House grounds, the stadium at the U.S. Open and a college football game.

There are questions about the nature of some of the sightings reported to the FAA.[15] For instance, questions have been raised as to whether certain reported sightings involve birds rather than unmanned aircraft or were instances in which an unmanned aircraft was visible to pilots but did not entail a loss of safe separation between aircraft.[16] In one case, a collision between an airliner and a UAS reported by a flight crew was later determined to be a bird strike.[17] In other cases, some questionable unmanned aircraft operations included in the FAA data were conducted by government agencies (including a local police department and the military) rather than errant consumers.[18]

The increase in reported UAS sightings by pilots as well as accelerating sales of unmanned aircraft to consumers concern stakeholders and the public for several reasons. First, safety is paramount, and unauthorized operations of unmanned aircraft create the possibility of a midair collision with a conventional aircraft that could result in injuries or the loss of life. Furthermore, other stakeholders say the FAA should develop methods for objectively measuring and analyzing the risks associated with UAS operations. Finally, stakeholders have expressed concern that unnecessarily restrictive government policies or the actions of irresponsible individuals could hamper or even cripple the development of the commercial UAS industry.

Solutions

Efforts are underway to address these risks through improved education, better enforcement of existing laws and technological means. For example, FAA has joined industry trade groups, manufacturers and other stakeholders on "Know Before You Fly" an educational campaign to provide prospective users of unmanned aircraft with the information they need to safely and legally operate in the nation's airspace. There are also private sector-led efforts to use technologies such as geo-fencing and enhanced aircraft detection to mitigate the risks.

This hearing will enable the Subcommittee to better understand the nature and extent of potential risks posed by unmanned aircraft to aviation safety, how to measure and analyze possible risks, and what technological, educational and policy solutions should be used to mitigate such risks.

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[15] *See* A Closer Look at the FAA's Drone Data, *available* at http://www.modelaircraft.org/gov/docs/AMAAnalysis-Closer-Look-at-FAA-Drone-Data_091415.pdf

[16] Bart Jansen. *Drone hobbyists find flaws in "close call" reports to FAA from other aircraft*, USA Today, Sept. 14, 2015.

[17] Whitlock 2015. *Supra.*

[18] Jansen, *Supra.*

WITNESS LIST

Michael G. Whitaker
Deputy Administrator
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James Hubbard
Deputy Chief, State and Private Forestry
United States Forest Service

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Air Line Pilots Association

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Dr. Mykel Kochenderfer
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ENSURING AVIATION SAFETY IN THE ERA OF UNMANNED AIRCRAFT SYSTEMS

WEDNESDAY, OCTOBER 7, 2015

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON AVIATION,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
Washington, DC.

The subcommittee met, pursuant to notice, at 10 a.m. in room 2167, Rayburn House Office Building, Hon. Frank A. LoBiondo (Chairman of the subcommittee) presiding.

Mr. LOBIONDO. Good morning. The subcommittee will come to order. I would like to thank everyone for being here. I ask unanimous consent that Members not on the subcommittee be permitted to sit with the subcommittee at today's hearing, offer testimony, and ask questions.

[No response.]

Mr. LOBIONDO. Without objection, so ordered.

Today we look forward to hearing from various stakeholders on the very important topic to our country: aviation safety in the era of unmanned aircraft systems.

Unmanned aircraft systems, or UAS, represent the latest frontier in aviation technology. While still a new industry, UAS are already contributing to our economy and changing how companies do business. Across the country, we already see UAS used for a myriad of operations, from surveying, photography, safety inspections, medical delivery, and search and rescue. With each new use, businesses and commercial users can save time, money, and even, in some cases, lives.

But like any other new technology, UAS bring new challenges as well. In the past year, pilots have been reporting sightings of UAS near airports at an accelerating rate. In 2014, the FAA [Federal Aviation Administration] received 238 reports of drone sightings. In 2015, the number has already exceeded 600. Safety is paramount in aviation and the increased number of suspected sightings raises serious questions and concerns.

Some of these reports involved airliners and occurred at low altitudes near the Nation's busiest airports. Other reports involve pilots of general aviation aircraft in less busy airspace. The real possibility of a midair collision must be taken seriously in order to prevent tragic consequences.

To be clear, it is also my understanding that some of these reported sightings may involve something other than a consumer unwisely operating their new gadget in busy controlled airspace or restricted airspace. In at least some cases, the reported UAS may

have been a Government-operated aircraft, lawfully operated UAS, or simply a bird in flight. To that end, we need to understand what precisely is going on in our airspace: what is the actual risk and how do we manage and mitigate it? With retailers readying for significant UAS purchases by American consumers this upcoming holiday season, this conversation and subsequent action cannot wait. There are real consequences if we are not cautious enough, though we must not go to the extreme which could unnecessarily restrict the UAS industry's growth and innovation here in the United States because of the so-called false positives.

The key is balance, and I believe that this committee, as well as the FAA and stakeholders, continue to strive for just that, balance. The answer to these questions will be complex, though I am confident that our country can and will address them. I look forward to hearing from our witnesses and thank them for joining us today.

Before I recognize Mr. Larsen for his comments, I ask unanimous consent that all Members have 5 legislative days to revise and extend their remarks, and include extraneous material for the record of this hearing.

[No response.]

Mr. LOBIONDO. Without objection, so ordered.

I would now like to yield to Mr. Larsen for his opening remarks.

Mr. LARSEN. Thank you, Chairman LoBiondo, for holding today's hearing on ensuring aviation safety in an era of unmanned aircraft systems.

I am pleased we are here this morning to address this important and timely topic of the safety of UAS in the national airspace. The number of unmanned aircraft being sold in the U.S. is staggering. According to one industry group, the number of UAS sold this year could reach 700,000. That is a 63-percent increase over last year. Other reports suggest that figure will soon reach 1 million, and it will continue to grow.

So, the natural question becomes who are flying these million-plus unmanned aircraft? Many, as we are going to hear, are responsible and safe users. These include serious hobbyists, such as those represented by the Academy of Model Aeronautics, who are here today, and commercial users with a financial interest in safe, responsible operations.

But, unfortunately, they also include people who are not familiar with the rules of aviation or concepts of aviation safety. There are 600-plus reports of near misses between conventional aircraft and drones so far this year that tells us what we need to do more to reduce the likelihood of a drone ending up in the flight path of a commercial airliner with hundreds of people on board.

These 600-plus pilot sightings suggest that allowing anyone to fly a drone on or near the Nation's airways is like letting people drive remote-controlled model cars on the interstate. Unless more is done, it is not if an accident will happen, it is when.

The committee staff found some pilot reports in NASA's [National Aeronautics and Space Administration's] Aviation Safety Reporting System of some pretty scary encounters. One pilot reported that he "encountered a drone that came close enough to hear the propeller noise from the drone from inside my cabin...The small

size of the drone made it impossible to see until it was too late to take any evasive action." And the list continues.

In addition to risks in the air, unmanned aircraft pose risks on the ground. This year an aerial vehicle crashed into parade-goers in Seattle, injuring one woman when it crashed into her head. I look forward to hearing from our witnesses today about what the FAA and stakeholders are doing to address the safety risks before it is too late.

But we cannot deny the extensive public and commercial benefits of unmanned aircraft, as well. UAS can be used for search and rescue, wildfire mitigation, as well as the inspection of bridges and other critical transportation infrastructure. The UAS industry has great potential to drive growth and create jobs. One industry trade group estimates that, in just 10 years, unmanned aircraft will create 100,000 jobs, and add $82 billion in value to our economy. That is particularly important to States like my home State of Washington, a hub of aviation research and development.

This committee has an enormous opportunity to be proactive, to listen to these experts today, to understand what Congress can do to help keep our Nation's skies safe, and produce legislation about UAS that will reflect our safety agenda, while doing no harm to a promising industry.

The FAA Act of 2012 directed FAA to safely integrate unmanned aircraft by 2015, and required the agency to issue regulations on small, unmanned aircraft. While FAA expects to issue this delayed rule next year, this action will provide regulation to safely implement primarily commercial operations. The question I hope we get at today is what should Congress do, and what can FAA do, as well, to ensure the safety of recreational UAS operations.

Some have said that section 336 of the 2012 bill prohibits the agency from taking any meaningful action to regulate small recreational unmanned aircraft. I would caution against a broad interpretation of that provision, which is crafted to apply very narrowly. In fact, in light of all the safety events that have emerged this year, maybe it is time to revisit that provision.

So, I look forward to hearing from all of our panelists today about what Congress, about what the FAA, and, importantly as well, what the industry can do to keep the integration of UAS on track, and to ensure safety. Thank you.

Mr. LOBIONDO. Thank you, Rick. I would like to really thank Rick Larsen for the close working relationship, and also Bill Shuster and Peter DeFazio, on this very important issue that we spend a lot of time with.

Chairman Shuster is not here yet. Mr. DeFazio, some opening remarks?

Mr. DEFAZIO. Thank you, Mr. Chairman. Appreciate the opportunity, appreciate the fact of you convening the committee on this important topic today.

Yes, there is tremendous potential in commercial application of drone technology. But, first and foremost, we have to establish the rules that absolutely ensure the integrity and the safety of our aviation system today. We have seen instances mentioned by the ranking member earlier of these toy drones in critical airspace. At this point we don't really know what happens when you suck a

quadcopter into a jet engine. And, at my request, the FAA is moving forward with an evaluation.

We did, after an investigation in 2009 for Pittsburgh—or 1994, Pittsburgh, possible bird strike, they calculated a 4-pound bird hits an airplane moving at 260 miles an hour, generates a force equal to 14 tons. Well, you have some of these toys up there in the air that weigh that much. And so, what could that do, if ingested? So we need to know.

What are the solutions? Well, clearly, there are commercial applications, which the FAA is moving forward with. The issue, I believe, can be kind of drawn between toys and commercial applications. And the toys need to be restricted, in terms of where they can operate. That is, they should be programmed before they can be sold, so that they can't fly in restricted airspace, they can't fly over 400 feet. And anybody who is found to have hacked that should be subject—and operates irresponsibly—should be subject to serious penalties and fines.

I think we might also have to look at registration. I had an instance in my hometown of Springfield. Somebody, a Peeping Tom, was using a little drone, looking with a camera, looking in people's windows. It was sighted by the neighbors, and ultimately it crashed. Well, the police have no idea who was operating that thing. We have no way to track it back. There should be a way to track these things back to irresponsible operators, people who are using them illegally, improperly, and endangering both personal privacy and, potentially, safety of the traveling public.

So, I think there is a lot of work to be done. We are going to hear today from the Forest Service. We had interruption in critical firefighting activities this summer because of idiots flying their toy drones into areas where we wanted to operate aircraft to fight the fire, and they had to suspend operations.

There needs to be consequences for people who do those sorts of things, and I expect this committee to work with the FAA to see if they have the authority to take proper action against these sort of people, or whether they need new authorities, and we need new regulations, so that we can divide between people who are using them responsibly, whether for recreation, or those who are using them responsibly and commercially, and those who are the minority, who are using them irresponsibly.

I was called by a reporter last week. They said they expect 1 million of these toy drones to sell for Christmas this year, 1 million. How many of those million people have any idea—obviously, a lot of them live in restricted airspace—what restricted airspace is, and whether or not they can operate the drone there? I don't think they know. So there also has to be a massive educational campaign, in part, which should be pushed forward and paid for by the manufacturers of these toys, who are profiting from their sale. With that, Mr. Chairman, I look forward to the testimony. Thank you.

Mr. LOBIONDO. Thank you, Mr. DeFazio. I want to thank our witnesses for being here today. They are Michael Whitaker, Deputy Administrator for the Federal Aviation Administration; James Hubbard, Deputy Chief of State and Private Forestry for the United States Forest Service; Captain Tim Canoll, president of the Air Line Pilots Association, International; Richard Hanson, director

of government and regulatory affairs for the Academy of Model Aeronautics; Dr. Mykel Kochenderfer—am I correct there, Doctor? Thank you. Assistant professor of aeronautics and astronautics at Stanford University.

Deputy Administrator Whitaker, you are now recognized for your statement.

TESTIMONY OF MICHAEL G. WHITAKER, DEPUTY ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION; JAMES HUBBARD, DEPUTY CHIEF, STATE AND PRIVATE FORESTRY, U.S. FOREST SERVICE; CAPTAIN TIM CANOLL, PRESIDENT, AIR LINE PILOTS ASSOCIATION, INTERNATIONAL; RICHARD HANSON, DIRECTOR OF GOVERNMENT AND REGULATORY AFFAIRS, ACADEMY OF MODEL AERONAUTICS; AND MYKEL KOCHENDERFER, PH.D., ASSISTANT PROFESSOR OF AERONAUTICS AND ASTRONAUTICS

Mr. WHITAKER. Chairman LoBiondo, Ranking Member Larsen, members of the subcommittee, thank you for the opportunity to appear before you today to discuss——

Mr. LOBIONDO. Excuse me, could you pull your mic a little closer?

Mr. WHITAKER. I will scoot closer.

Mr. LOBIONDO. Thank you.

Mr. WHITAKER. OK. To discuss the safe operation of unmanned aircraft.

The popularity and variety of unmanned aircraft have increased dramatically in recent years. Many commercial uses are becoming commonplace today, including infrastructure inspection, surveying agriculture, and evaluating damage caused by natural disasters. UAS play an increasingly important role in law enforcement, firefighting, and border protection.

At the same time, the demand for recreational drones has exceeded anyone's expectations. This demand is driven, in large part, by individuals who are completely new to the aviation experience. They are not necessarily the traditional model airplane operators, members of local clubs who follow safety guidelines and rules. These new entrants are often unaware that they are operating in shared airspace. The proliferation of small and relatively inexpensive UAS presents a real challenge.

To successfully integrate unmanned aircraft into our airspace, we must integrate these new operators into our aviation safety culture. We want people to enjoy this new technology, but we want to make sure they do it safely. This requires education, as well as creative and collaborative public outreach.

This is why we have joined with our industry partners, including several seated at the table today, to launch the Know Before You Fly campaign. This effort provides UAS operators with the guidance they need to fly safely, and is raising awareness of where they can and cannot fly.

We also have an ongoing No Drone Zone campaign. This campaign reminds people to leave their unmanned aircraft at home during public events, such as football games and, most recently, the Pope's visit to several major U.S. cities.

However, we firmly believe that education and enforcement must go hand in hand. Our preference is for people to voluntarily comply with regulations, but we won't hesitate to take strong enforcement action against anyone who flies an unmanned aircraft in an unsafe or illegal manner. When we identify an operator who endangers other aircraft, or people and property on the ground, we will work with our local law enforcement partners to prosecute these activities.

To date, the FAA has investigated hundreds of incidents of UAS operating outside of existing regulations. Earlier this week the FAA proposed a $1.9 million civil penalty against a company that knowingly conducted dozens of unauthorized flights over Chicago and New York. This sends a clear message to others who might pose a safety risk: Operate within the law, or we will take action.

We recognize that the technology associated with unmanned aircraft is continuing to evolve. This is also true for the many technologies that could further advance the safety and capabilities of these aircraft. Earlier today we announced a research agreement to evaluate technology that identifies unmanned aircraft near airports. Working with our Government and industry partners, we will assess this capability in an operational environment without compromising safety.

We recognize, too, that our regulatory framework needs to keep pace with technology. The FAA Modernization and Reform Act of 2012 laid out a framework for the safe integration of unmanned aircraft into our airspace. The FAA has taken a number of concrete steps toward accomplishing this goal.

A key component of these efforts is finalizing regulations for the use of small, unmanned aircraft. Earlier this year, we proposed a rule that would allow small UAS operations that we know are safe. The rule also meets the majority of current commercial demand. The FAA received more than 4,500 public comments on this proposal, and we are working to address those as we finalize the rule.

The rulemaking approach we are using seeks to find that balance that you referred to, Mr. Chairman, that allows manufacturers to innovate while mitigating safety risks. We also recognize the need to be flexible and nimble in how we respond to the emerging UAS community. As technologies develop, and as operations like beyond line of sight are researched, we want to be able to move quickly to safely integrate these capabilities.

While we have made substantial progress on UAS in recent months, we still have more work to do. Recently, the FAA elevated the importance of unmanned aircraft issues within the agency by selecting two seasoned executives to oversee our internal and external integration efforts. Major General Marke Gibson, U.S. Air Force (Retired), and Earl Lawrence, who most recently served as manager of FAA's Small Airplane Directorate. Both of these gentlemen are seated behind me with me today.

The FAA has a long history of integrating new users and capabilities into our airspace, and we are well equipped to apply this experience in the area of unmanned aircraft. I am proud of the team we brought together to accomplish this, and of the approach we are taking to ensure America's aviation system remains the safest in the world.

Thank you, and I am happy to answer any questions you may have.

Mr. LOBIONDO. Thank you, Mr. Whitaker.

Mr. Hubbard, you are now recognized.

Mr. HUBBARD. Thank you, Mr. Chairman, members of the committee. The Forest Service, just as a little bit of background of how we get into this, our latest fire season we responded to 47,000 fires. We had 9 million acres of affected territory. We mobilized 27,000 people, with another 5,000 in reserve for initial attack.

The future of wildland fire, especially in the West, is probably not going to be much different than that. It—the vegetative conditions, the drought, and the nature of our forests is going to be prone to this kind of fire for some time to come.

Our primary initial attack firefighting tool is aviation. We send air tankers as fast as we can. They don't put fires out, ground troops do, but they are an initial attack response. They also support large fire, and our priority is always life and property, so that gets the most attention.

Unmanned aviation systems are also useful to us. In firefighting they help us with situational awareness, they help us with communication, they help us with monitoring and tracking fire behavior, all safety issues that are valuable.

Our challenge is the incursions. I wouldn't say that our statistics are significant compared to everybody else's, but the trend is a little bit worrisome. In 2014, we only had four incursions. In 2015 we had 21 incursions. So it is on the rise. Twelve of those incursions stopped those initial attack operations. That is not something that we welcome.

And it is further complicated because we are talking about aircraft that operate in a complex environment. We are talking about rotary aircraft, as well as fixed-wing aircraft over the fire at the same time. We are talking about 150 feet of operational altitude. We are talking about, prior to, temporary flight restriction. So it is not a simple matter.

We don't presume to know how to address this. We rely on the FAA. But the Department of the Interior and the Forest Service and the State firefighting organizations all worked together with FAA and the Department of Homeland Security on the technology and how to work our way through this.

In the meantime, public education is important. When we have fire, flames, and smoke in the air, we do get some media attention, and we incorporate into that as a regular message that, if you fly, we can't. So, trying to get that kind of a word out so people understand. A lot of this is from those who don't understand.

So, our risks are significant, we believe, if something were to happen in the air with a drone and our aircraft. Our frequency is not that much, but the trend would—is worrisome. We worry about the risk of identification and avoidance, so a few problems to solve.

We also recognize that this is—UAS is a valuable tool that we also take advantage of. Be happy to answer any questions.

Mr. LOBIONDO. OK, thank you, Mr. Hubbard.

Captain Canoll, your statement, please.

Mr. CANOLL. Thank you, Chairman LoBiondo, Ranking Member Larsen, and the subcommittee, for the opportunity to be here today.

ALPA [Air Line Pilots Association, International] recognizes that unmanned aircraft systems, or UAS, can allow us to perform certain tasks more efficiently and safely than conventional aircraft. We also understand the value of advancing America's competitiveness in these technologies. That said, ALPA's overarching concern is one of safety.

This summer the FAA released hundreds of pilot reports on UAS sightings. The FAA numbers show more encounters are happening more often. Noncommercial and recreational UAS operations appear to be the primary source. Here are a few examples: pilots operating an all-cargo flight near San Jose reported a close encounter with a UAS flying 60 to 70 feet to the left of the aircraft. They subsequently described it as four-bladed and X-shaped. As an airline captain, I can tell you if a pilot is able to report this level of detail, the UAS is way too close.

Also, multiple UAS were recently reported by three airliners on final approach to Newark Liberty International Airport. In April, a pilot reported a blue metallic drone pass about 100 to 200 feet under the left wing of the airliner arriving at Seattle-Tacoma International Airport.

For pilots, these UAS literally appear out of the blue. They are much smaller than other aircraft. Some UAS do not have lights. They have limited contrast against visual background, and they move much more slowly than airliners. As a result, these UAS are extremely difficult to see in flight.

[Video shown.]

Mr. CANOLL. In this example, you can see how the white color of the UAS blends in with the sky. Imagine trying to detect this UAS while flying at 280 miles an hour.

The number of near-miss events that have occurred in such a short period of time demonstrate the risk. The growth in the use of these systems shows the hazards will only increase. The United States must put safety first. The FAA is making progress, but we need to do more. While work on the final rule regarding small commercial UAS operations is encouraging, the agency must immediately address all UAS operations, including recreational and noncommercial.

ALPA's recommended plan, action plan, has four elements. Number one, education. Anyone who plans to fly these UAS must understand the aircraft, the airspace, and the other aircraft that share it. For those who want to do the right thing, there are resources such as the Know Before You Fly campaign, of which ALPA is a supporter. But we also need to reach, at the point of sale, those individuals who may not yet appreciate the danger. Individuals flying these UAS for recreation must adhere to the FAA guidelines, including any minimum age requirements, maintaining line of sight, and flying under 400 feet.

Number two, registration. Gathering contact information about the UAS purchaser will not only allow authorities to immediately identify the owner, but it will also drive home the serious nature of operating these vehicles.

Number three, technology. If these UAS operate in the airspace intended for airliners, or they could unintentionally end up there, airline pilots need to be able to see them on their cockpit displays, controllers need to be able to see them on their radar scopes, and the UAS must be equipped with active technologies to ensure it is capable of avoiding a collision with manned aircraft. If regulations restrict the UAS from operating in a particular location, the UAS must have technology that cannot be overriden to limit its operations. Penalties for those who deliberately bypass this technology must be significant.

Number four, penalties and enforcement. UAS pilots must be properly trained and understand the consequences of exceeding the operating limitations and the possibility of malfunctions. Anyone deliberately flying a UAS recklessly should be subject to criminal prosecution. Anyone who is operating a UAS and unintentionally deviates from rules and limits should be subject to civil penalty. ALPA welcomes the FAA's recent proposed civil penalty against a UAS operator for endangering the safety of the airspace around New York City and Chicago.

With this four-part action plan, our country can capitalize on the economic opportunities offered by these UAS while maintaining safety. Given the safety risks highlighted by the FAA's recent release of pilot reports, ALPA urges Congress to direct the FAA to regulate UAS operated for recreation and hobby. ALPA stands ready to help the FAA develop these regulations as part of realizing our shared goal of ensuring the safety of air transportation for all who depend on it. Thank you, sir.

Mr. LOBIONDO. Thank you, Captain.

Mr. Hanson, you are recognized.

Mr. HANSON. Thank you for the opportunity to participate in today's hearing. I am speaking on behalf of the Academy of Model Aeronautics, the world's largest organization representing more than 180,000 members who fly small, unmanned aircraft systems, or model aircraft, as we call them, for recreational and educational purposes.

For nearly 80 years, AMA has been dedicated to promoting and preserving the hobby of flying model aircraft, while ensuring our members adhere to a strict set of community-based safety guidelines. Our National Model Aircraft Safety Code has been recognized by Congress and State legislatures as a safe and effective means of managing hobbyists. These guidelines have evolved to accommodate new technologies, new modeling disciplines, and, most recently, address the personal use of small UAS. Our membership is a cross-section of America. It is a diverse community of youth and adults that range from the ages of 6 to 96.

As you know, there is an unprecedented growth in the industry. According to the Consumer Electronics Association, sales in the U.S. this year will reach 700,000 units. The growth of the technology and the supporting industry is exciting, and is beneficial to our economy and to our society. But, as with any emerging technology, there are policy considerations, such as balancing safety, sustaining industry growth, and capturing the public benefits.

Before I touch on these points, I want to take a step back and discuss the current landscape. We have been very concerned about

recent headlines that portray drones as clogging U.S. airspace, snarling air traffic, and giving the FAA fits. That is why the AMA [Academy of Model Aeronautics] closely analyzed the 764 records of drone sightings released by the FAA this summer. Our analysis reveals a more complex picture than headlines would suggest.

Indisputably, there are some records of near misses that represent actual safety concerns. And more needs to be done to address those. But we found that the number of near misses appears to be in the dozens, not in the hundreds, based on explicit notations in the FAA records.

So, the most serious incidents include two actual crashes involving Government-authorized military drones. There are also sightings of public entities and commercial operators that may be flying with or without authorization. And the most recent sighting or incident where the FAA has assessed a fine to a commercial operator indicates that the operations occurring in our airspace go well beyond hobbyist activity. And others may not even be drones, but rather, balloons, birds, model rockets, and mini blimps.

There is some useful information in the FAA's data set, but this data is only helpful if the FAA, the media, and others take the time to analyze and accurately categorize it. AMA has worked closely with the FAA for many years, and we are committed to a continued partnership to promote model aircraft and consumer drone safety. And while the FAA needs to do a better job of presenting the data, AMA has several recommendations to ensure the safety of our Nation's airspace.

One of the most immediate and helpful things the FAA can do to increase safety is to finalize and implement the small UAS rules. As they are currently written, the proposed rule will enhance safety by requiring everyone who wants to fly to either participate in the safety programming of a community-based organization like AMA, or follow new FAA rules for operators for commercial purposes. Once implemented, the new rules will help provide oversight and education for the UAS operators.

At the same time, the FAA should step up enforcement as they have currently demonstrated, and work more closely with local law enforcement to pursue bad actors. There are existing Federal prohibitions against careless and reckless operations, and many jurisdictions have criminal laws in place.

In addition, promoting safety through education is another important step we can all take. AMA members know where and where not to fly, and do so safely and responsibly. Unfortunately, many newcomers to UAS may not be aware of these safety considerations.

That is why the AMA, in partnership with the Association for Unmanned Vehicle Systems International and the FAA, launched the Know Before You Fly campaign during the last holiday season. Unmanned aircraft systems are going to be a reality within our communities, and it is a community approach that is going to best address that. This new campaign works to put important safety information and flying tips in the hands of the newcomers. Many organizations from the manned and unmanned communities have joined the campaign, including the Air Line Pilots Association that is here with us today.

Finally, it has been suggested that technology itself can be the solution. And, to the industry's credit, many of the leading companies that manufacture UAS for both commercial and recreational purposes have developed and implemented technologies that address some of the concerns. While technology can be a useful tool for situational awareness, it is no substitute for education.

In the aviation world, there is a longstanding tradition of putting the responsibility for safety in the hands of the pilot and the person operating the aircraft.

I thank you again for this opportunity to participate, and I look forward to answering any questions you might have.

Mr. LOBIONDO. Thank you, Mr. Hanson.

Dr. Kochenderfer?

Dr. KOCHENDERFER. Chairman LoBiondo, Ranking Member Larsen, and members of the subcommittee, I am a professor in the Department of Aeronautics and Astronautics at Stanford University, and I am a third-generation pilot. My research for nearly 10 years has involved statistical estimation of risk and the development of technology for enhancing aviation safety.

Personally, I find the rapid acceleration of unmanned aircraft technology to be the most exciting recent development in the field of aeronautics. The proliferation of unmanned aircraft has made aviation accessible, and has inspired a generation of eager university students in a way that we haven't seen for a long time. The growing popularity of these vehicles has also raised concern about safety.

So how do we go about measuring and analyzing these risks? To answer this, we must understand that risk is determined by both the likelihood and the severity of different hazards.

First, let us consider severity. A sufficiently large drone can damage any part of an aircraft. But one of the most severe hazards is engine ingestion. The US Airways flight in 2009 was struck by multiple Canada geese. Of course, a flock of sufficiently large drones could cause similar damage. However, flocks of drones are rare, and most consumer drones, just like the DJI Phantom, are less than one-third of the weight of a Canada goose.

I am not aware of any engine ingestion testing of the Phantom, but it is certainly conceivable that it would cause some degree of damage to an engine, but probably not of the severity that occurred with the US Airways flight.

What is the likelihood of a midair collision involving a drone? In order for a collision to occur, the drone has to be at the same altitude and the same geographic location as another aircraft. An analysis of radar data indicates that there are large areas of the country where the risk of encountering another aircraft is negligible. However, there are portions of the airspace where the likelihood of a collision is orders of magnitude more significant.

There are several technologies that can help mitigate risk. Altitude limits can be implemented fairly reliably, and only require a barometric altimeter. Implementing geofencing is more difficult, because it relies on an up-to-date database of geofence locations and accurate GPS location. But the safety risks can be significantly reduced with such technology.

I am not a policymaker, but I believe that it would be wise to set altitude limits for drones capable of flying above 400 feet. The cost to add this safety feature, if it doesn't already exist, is fairly negligible. Most drones capable of flying above 400 feet already have an altimeter.

One of the first things a new user might do after opening the box is to see how high the drone can go. This altitude limit would not ensure safety or prevent interference with firefighting on its own, but it will certainly help naive users and discourage reckless users. Preventing a conscientious user like a firefighter from overriding an altitude limit is problematic. The exact approach for overriding limits is still being thought through by industry, and I believe it is too early to mandate a particular mechanism.

Altitude limitations in geofences are near-term risk mitigation measures, but it is becoming clear that some kind of infrastructure is needed to facilitate the integration of commercial drones into the airspace. NASA Ames, in collaboration with industry and academia, has been pursuing the development of the UAS traffic management system. However, there is still tremendous research to be done.

When flying in the same airspace as manned aircraft, a sense-and-avoid system is likely to be necessary to help prevent collision. The FAA has successfully flight-tested the ACAS X system [Airborne Collision Avoidance System X] for large drones, and some of the technology may extend to smaller drones.

In conclusion, the growing popularity of commercially available drones presents a risk that should not be ignored. Education should play a major role in risk reduction. In addition, there are technologies that can be easily implemented by manufacturers to help prevent inadvertent airspace violations. It is in the interest of the drone industry to implement these safety measures. It is in the interest of our Nation to support the research needed to ensure aviation safety as our technology evolves.

Thank you for the opportunity.

Mr. LOBIONDO. Thank you, Doctor.

Mr. Whitaker, in addressing illegal UAS flights, do you feel there are any additional authorities that the FAA believes Congress can or should provide to curtail or penalize wrongful operation of UAS?

Mr. WHITAKER. We are currently doing a review of our authorities internally, with DOT, and also with other agencies. But one of the challenges with this issue is actually locating the UAS operators. It is less a question of authority or magnitude of penalties as it is actually locating the operators.

If you look at these pilot reports, they tell us where the UAS is, but they don't tell us where the operator is. If you contrast that with laser strikes, the pilot usually knows exactly where that strike is coming from. So one of the biggest challenges we are having is locating the operators in the first place, which is why our emphasis has been on education and beefing up that methodology.

Mr. LOBIONDO. And also for you, Mr. Whitaker, according to new reports, Government agencies and private companies have acquired and deployed drone detection systems that utilize some combination of radio frequency, thermal detection, video, and audio technology that can immediately locate the UAS and its operator.

Is the FAA considering similar detection technologies as part of the agency's efforts to mitigate the risk of a midair collision between a UAS and manned aircraft?

Mr. WHITAKER. We announced today a new research partnership that goes just to that issue, that deploys a technology at airports that allows you to survey the area within 5 miles of the airport and detect radio signals from UAS. So that technology is going into testing, and it is one of a variety of technologies that we are looking for to detect drones in the airport environment.

Mr. LOBIONDO. So you will assess the two testing programs to determine how you proceed from there?

Mr. WHITAKER. We will assess the results of that technology, as well as geofencing and some other technologies, to try to develop an approach, again, in conjunction with other agencies that have a security issue involved here, as well.

Mr. LOBIONDO. So the pilot programs that you announce today, can you give us any timelines on these, of when they will be operational at those locations?

Mr. WHITAKER. The technology is an existing technology, so we—there hasn't been an announcement of location or timeframe yet, but that should be coming shortly.

Mr. LOBIONDO. OK. Mr. Larsen?

Mr. LARSEN. Mr. Whitaker, in previous meetings I have had within the office, private industry technology folks have suggested to me to—that they require registration of the product that individuals purchase, and then share that information with the FAA as a way to track or have a database where you can track use, in the event of a violation. Have you heard that from private industry?

Mr. WHITAKER. We have a number of initiatives that private industry has put forth to help in this effort, including informational paperwork in the packaging itself. The Secretary himself has indicated that he thinks registration may be one of the answers to part of this problem, and we are evaluating that as an option for all UAS.

Mr. LARSEN. Yes, in conjunction with private industry, because most times, when you buy a piece of technology these days—or if you buy a toaster—you register your product online for warranty purposes, as a for instance, so people do this all the time. But——

Mr. WHITAKER. Yes.

Mr. LARSEN [continuing]. The concept that you would then share that—that would be shared, though, with an agency might cause some caution. But this is an idea that has come out of private industry.

Mr. WHITAKER. And I think we would have to work closely with industry to decide the best way forward for that. We would not be set up to take this level of registration data, and we would want to make sure——

Mr. LARSEN. Yes.

Mr. WHITAKER [continuing]. It is accessible, if we do that, and also that it can be used for law enforcement purposes.

Mr. LARSEN. Right, right. Can you talk a little more about coordination between agencies, maybe with USFS [U.S. Forest Service]?

Or an example that happened in my district, we have orca pods in the Puget Sound and near the San Juan Islands. They are a big

driver of tourism, of the tourism economy up there. But people have to comply with the Marine Mammal Protection Act. U.S. Fish and Wildlife fined an aerial photographer for violating the MMPA—that is, getting too close to the orca pods, which then—he put this aerial photography and video up on his Web site to advertise himself, basically showing everyone how he violated MMPA, and then was fined for that.

Is that something that runs across your desk at FAA, or can you talk a little bit about how you coordinate with agencies?

Mr. WHITAKER. We have a large number of ways that we coordinate. Under the DOD [Department of Defense] authorization, there is an EXCOM [executive committee] that meets on UAS that includes DHS [Department of Homeland Security], DOD, FAA, and NASA. We have an interagency group that meets quarterly that includes those agencies plus Commerce [Department of Commerce] and others to talk about NextGen, as well as UAS. We have a facility that we run at headquarters that is a 24/7 monitoring of events in the NAS [National Airspace System], and we coordinate with law enforcement agencies through that. And DHS has taken the lead on security issues focused on the Capital, but also airport environments. And they run that, and we participate in that. So there are really a huge number of fora that we participate in to have that interagency coordination.

Mr. LARSEN. Yes, good.

Mr. Hanson, I have had a chance to meet a couple of your members. Your district XI vice president is Chuck Bower and then Ken Woblick is the president of the Whidbey Island Radio Control Society there, and they have attended a few town halls. So I want to commend you on your grassroots organizing on this issue.

Mr. HANSON. Thank you.

Mr. LARSEN. But on that perspective, from a local perspective, how would your members look at or—look at registration of UAS purchases, and using that as a database for enforcement, in the event of an incursion, a potential violation?

Mr. HANSON. Well, I believe our members understand that registration at some level certainly makes sense. And I think it needs to be understood that there is a broad spectrum of platforms that are being called drones.

Mr. LARSEN. Right.

Mr. HANSON. And the vast majority—I am going to guess somewhere around two-thirds—of the numbers that we have been hearing today are really what we would put in the toy category.

Mr. LARSEN. Yes.

Mr. HANSON. They have a very short lifespan, and they have limited ability to accommodate the type of technology that we are talking about. So, as long as we are identifying the proper threshold where registration starts to make sense, I think they would be very acceptant of that.

It is also important to know that they are used to a similar type of process within our community. Every member is required to put their AMA number or their name and address within their aircraft. That is for a number of reasons. Hopefully, if it gets lost, we are hoping somebody will return it to us. But, beyond that, it also helps identify the owner-operator for accountability purposes.

Mr. LARSEN. Yes, I will just—and on that point, I was noting yesterday with staff that the crabbing industry is big in Washington State, as well, and you have got to put your name and address and a contact number on your crab pot buoy, in case it gets loose, or in case someone steals it. But you have to do this, because you need to be held accountable. And so it is the same kind of deal?

Yes, Mr. LoBiondo, did you have a question for me?

[Laughter.]

Mr. LOBIONDO. You could have drones monitor the crab pots.

[Laughter.]

Mr. LARSEN. That is next.

Mr. LOBIONDO. That is next. Thank you, Mr. Larsen.

Mr. Young?

Mr. YOUNG. Thank you, Mr. Chairman, and the ranking member, for holding this hearing. You know, the University of Alaska in Fairbanks is named one of the designated area test sites for the UAS. But the frustration they have is the certification of authority process, Mr. Whitaker.

Is the FAA doing anything to shorten this process? They have been granted, but it takes a long, long time. Why does it take that long? Are you improving that time factor?

Mr. WHITAKER. We are, sir. We have taken several steps.

With respect to the test sites, we initially issued a blanket certificate of authorization for operations up to 200 feet. We recently, last month, increased that to 400 feet. So that really streamlines the paperwork process pretty dramatically. There may still be some exemption requirements, but they should be much fewer now. And the exemption process itself we have streamlined, but we do a safety analysis on each of the applications, so that does take some time. But it should be much more streamlined now.

Mr. YOUNG. Well, they are very complimentary to your efforts, but they just want to expedite the process. Now it is taking 1 year, 2 years sometimes. And we need to solve that problem. That is number one.

Mr. WHITAKER. Yes, most of the applications have been eliminated now for the test sites. But when they do come, they should be measured in days, certainly, not months or years.

Mr. YOUNG. Captain, what kind of equipment do you have on your aircraft for collision avoidance? You say you can't—you know, if you have to look for this drone, don't you have equipment in the airplane that can identify an object in front of you quicker than just by eyesight?

Mr. CANOLL. So, as demonstrated by the video, visual acquisition is very, very difficult in any aircraft.

Mr. YOUNG. Even with the radar system, the collision avoidance——

Mr. CANOLL. Well, we do have terminal collision avoidance systems in the aircraft, commonly referred to as TCAS. But they are equipped to operate to highlight other aircraft who are similarly equipped. So if the unmanned aerial system does not have a transponder on it, S-coded transponder, or isn't ADS–B [Automatic Dependent Surveillance-Broadcast] equipped, it will not show up on our displays in the cockpit at all.

Mr. YOUNG. Mr. Hanson, how did you get in such a good position, as far as model airplanes? I mean, for a while, you were under attack, because I remember that when I was chairman of this committee. And now, how did you achieve that? What can they do in this unmanned aircraft to make that same strides forward?

Mr. HANSON. I think the significant differentiation between our community and this newer community of users is the approach that we take to the hobby. I mean people get into this hobby, at least traditionally, because of their interest in aviation and their interest in learning how to build, fly, and operate their aircraft.

The newer communities are attracted more by the technology and the functionality of the aircraft, something it can do, such as taking pictures. In some cases it is not different from the smart phone. I mean they look at it as just an extension of your camera.

So we have a different mindset within this community, but, in our opinion, it does all boil down to an educational process that, as long as they understand the means by which they can operate safely and responsibly, we believe that the American citizen will do that. Not to say there aren't those individuals out there that would deliberately act irresponsibly, but until we can assuredly say that the consumer has that information in hand, it is a little hard to assess the mentality and the deliberate acts of the others.

Mr. YOUNG. Doctor, technology. You are an expert in that arena, a pilot. What would happen if we required the manufacturers to put a kill button in the unmanned aircraft if they got within a certain many feet of an airport? That is really what we are here for, the danger to the airplane that is flying, and the pilot who is flying. Could there be technology that way?

Because it is—most of these are battery-operated, correct? Very few of them are run by fossil fuels.

Dr. KOCHENDERFER. Yes, I would say the majority of the 700,000 or so that will be coming out are battery powered.

Mr. YOUNG. Sort of like electric fences—I drive my golf cart the other day, and you can't go close to the green because they have this communication that stops the golf cart. So why couldn't the technology be applied to any of these hobby drones where the thing dies?

Dr. KOCHENDERFER. I think that is what they are aiming at with geofencing. But you probably don't want it to die completely, because then it will fall out of the air and maybe hurt someone.

Mr. YOUNG. Well, you lose your drone, you won't do it again, I guarantee it.

Dr. KOCHENDERFER. Yes.

Mr. YOUNG. But I am just looking—the technology.

And, Mr. Chairman, if I may say, you at this table help us write this legislation. Because when we write legislation, 99 percent of the time it is screwed up. They don't really understand the problem unless we get input from those people directly—the airline, the FAA, the Government agencies, and those that have knowledge on how it works. So we have to use your input, Mr. Chairman. And I say this from experience of 44 years, that most of this legislation we have written doesn't work. And then, when the regulations come in, then we are all screwed up.

So I am just suggesting we use this expertise. Either solve this problem—a danger. That is really what we are here for. Mr. Chairman, I yield back.

Mr. LOBIONDO. Thank you.

Mr. DeFazio?

Mr. DEFAZIO. Thank you, Mr. Chairman. I was pleased to read that the FAA is going ahead with CACI [Conditions AMEs Can Issue]. I met with them earlier, and they were going to test their technology in Virginia this summer. It has been used in military applications. As they explained it to me, they can pinpoint the operator. That is good. They can do numerous things. They can force the drone to land, they can force it to go back to the operator. Or, in the case of hostiles, they deliver something to the operator.

So, the question, you know, would be, you know, how quickly are we going to move ahead with this? I am very disturbed at the 24 incursions on fires. How many of those people were prosecuted, or were even identified?

Mr. WHITAKER. I don't have statistics on how many. But, as I said before, it is very, very difficult to track them down, just by the nature of the UAS operation.

Mr. DEFAZIO. Right. So—and what about registration? You have heard that mentioned. You said you couldn't handle the volume. I mean were you just talking about an online database or something? What is the barrier to requiring registration?

Mr. WHITAKER. Well, there is interagency discussion going on about how that would be used, and what the logistics of it would be, what would be the best tool for that, whether it is at point of sale, how you verify ID, things of that nature. So there is some digging into the technicalities of that that is going on now.

Mr. DEFAZIO. Well, I would hope that doesn't take too long. I mean I already identified that one case in my hometown, where the police would really like to know who the person—the Peeping Tom was operating that drone, but we will never know.

So—and Mr. Young mentioned the idea that just—I mean you wouldn't want to necessarily disable them and have them drop out of the sky, but they can also direct them to another place. And if we have designated safe sites around airports or critical airspace, and we use this technology, we could direct the drones there and say, "Oh, come get your drone. We will be waiting."

So, I mean, this is a very, very—you know, I have been through almost 29 years in this committee, and we used to talk about the tombstone mentality at the FAA. And you know, I am very concerned about what this means to the safe operation of civil aviation in this country.

And beyond that, I am particularly concerned that it will also bring to a halt the legitimate commercial development of drones. I mean we take down one plane with one of these toys that someone is operating irresponsibly, or a terrorist uses, we are going to—this industry is going to grind to a halt altogether. We need to get a handle on this quickly.

Captain, do you have anything you want to add? Because, I mean, it was—Mr. Hanson, I—you know, I am sympathetic to the model folks. I used to build those things out of balsa wood with the little piston engines that didn't work very well, and all that stuff.

So I know that whole area. But we are talking about a whole new generation of people, the same people for whom the words "cell phone" and "etiquette" don't go together are now getting their hands on these drones, and I am worried about responsible operation. Captain?

Mr. CANOLL. No, I agree. And to differentiate, I thought it was an important point Mr. Hanson made about his members, who I generally believe are responsible operators, and those who are not part of his community who are operating these vehicles. They do have batteries in them, and these are dense, heavy metal pieces that will wreak havoc on aircraft.

When it hits a transport category aircraft, when it hits one, there is going to be a significant event. A significant event. Whether it hits the windscreen, some piece of the flight control system, or is ingested in the engine, this is going to be a significant event. And for the flightcrew, it is going to be a very challenging event to save the aircraft.

Mr. DEFAZIO. OK. Anybody want to comment on that?

[Laughter.]

Mr. CANOLL. It is not my intent to scare anybody here today——

Mr. DEFAZIO. No——

Mr. CANOLL [continuing]. But it is a significant event. OK, so an accident is never the result of a single episode. You can't point to any particular accident and say, "That was the sole cause of that accident," and I believe this is the same thing.

When we look at all the risks that we deal with in commercial aviation on a day-to-day basis, and we have to assign risks to each element of it—weather, traffic, communications, security within the cockpit, cybersecurity—we look for mitigations on every single element of that risk. This is another element to the risk chain.

And should it happen at a time when something else is going wrong, we are already dealing with a possible flight control malfunction, or a challenging communications or weather situation, and then we hit the drone, in some sort of—and always in a critical phase of flight, down below 10,000 feet, which is the highest likelihood of contact, that is when we have the highest risk of an actual accident.

And, you know, I think if you can't point to a single solution to this problem, it has to be a layered effect.

Mr. DEFAZIO. OK, thank you.

Thank you, Mr. Chairman.

Mr. LOBIONDO. Thank you, Peter.

Mr. Mica?

Mr. MICA. Thank you, Mr. Chairman, and thank you for holding this hearing.

Mr. Whitaker, what is today's date?

Mr. WHITAKER. Sir, it is the 7th of October.

Mr. MICA. What year?

Mr. WHITAKER. 2015.

Mr. MICA. And the legislation that we passed in 2012, the FAA Modernization Reform Act, had a directive to FAA. And what deadline did it set for you to finish the work that was assigned in the law on drones?

Mr. WHITAKER. September 2015, sir.

Mr. MICA. So we are behind schedule, obviously. If you review the record, when we passed this in 2012—and I believe that was February. Was it, staff? Yes. By the next year, 2013, you had completed the plan that is also required under the law, which was a good step.

You didn't propose the rule until January 20th of this year, right?

Mr. WHITAKER. That is correct, sir.

Mr. MICA. And you have had—the rule came out in February, so you have had February, March, April, May, June, July, August, September. We are just into October, so you have had 8 months to finalize that rule, and now you are saying that—and the rule—does the real rule just deal with the small aircraft?

Mr. WHITAKER. Small UAS under 55 pounds.

Mr. MICA. Under 55 pounds. Because I think we allowed a differentiation between small and large.

And you—at least the testimony I have heard is some time in 2016. Can you be more specific with "some time"?

Mr. WHITAKER. So the comment period was open until April of this year. We have had over 4,500 comments.

Mr. MICA. But the "some time" in 2016——

Mr. WHITAKER. And we are adjudicating those comments, and our internal objective is to get the rule out of FAA by the end of this year, and it will go through the review process at DOT and OMB [Office of Management and Budget]. And last time you and I discussed this——

Mr. MICA. February, March, April?

Mr. WHITAKER. Last time you and I discussed the point, we agreed on the date of June 17th, and I think that is still a solid date, and we should be able to beat that.

Mr. MICA. So not until next June?

Mr. WHITAKER. It should be in the first half of next year.

Mr. MICA. What about large?

Mr. WHITAKER. So the development of large UAS integration is going to depend, in large part, on commercial demand, and also, in large part, on technology. So that will develop as the technology develops and the demand develops.

Mr. MICA. Well, again, I am disappointed. What will probably propel this—maybe actually propel your schedule—is going to be a very serious accident, an incident. I can almost predict there will be one. There are just so many of these now flying, that it is almost inevitable that we have a drone hit an aircraft, and there will be, probably, injuries and hopefully not fatalities.

And this—these drones are up to 55 pounds. I remember going to a testing center when they would throw, like, a 40-pound frozen bird or something into an aircraft engine, and I saw what that did. These can do as much damage. And, you know, I don't need another test to show what would happen. But it probably will happen. Maybe that will speed things up.

You have had how many incidents? You said aircraft with drones that were somewhat serious, is it 200, 400? Captain Canoll, do you know?

Mr. CANOLL. So we don't keep the records that the airline——

Mr. MICA. OK. FAA, do you know how many have you had reported?

Mr. WHITAKER. We are at a rate of about 100 a month of pilot-reported——

Mr. MICA. One hundred a month? That is 1,200 a year. And so far you have sighted about—there has been about 20 enforcement actions. Did I hear that?

Mr. WHITAKER. That involve civil penalties, yes.

Mr. MICA. That seems very low.

The other thing, too, is in your plan—and I haven't reviewed the pending rule—do you have a provision for requiring—and maybe you can't do this, maybe we have to do it by law, but hundreds of thousands of these are being sold. A simple warning that says that you can't fly this within so close to an airport at such a height, that is not on the—required now on the sale of the unit. Is it in your proposal?

And can you do that, and—or should we do that by law? Because I think just letting people know when they purchase one of these what their obligations are is important.

Mr. WHITAKER. We have been working with manufacturers to have information put in the package——

Mr. MICA. Is it in your rule, proposed rule?

Mr. WHITAKER. The proposed rule deals with commercial operations.

Mr. MICA. Yes.

Mr. WHITAKER. And the issue is, really, the amateur operators. So we have been working with manufacturers to have the information voluntarily included, and an increasing number are doing that now. But we would have to have a rule to mandate it, which, A, we are not authorized to do, and, B, would take too long. So our focus——

Mr. MICA. So possibly——

Mr. WHITAKER [continuing]. Is the voluntary——

Mr. MICA [continuing]. A law. Thank you, Mr. Chairman. Yield back.

Mr. LOBIONDO. Mrs. Kirkpatrick?

Mrs. KIRKPATRICK. Thank you, Mr. Chairman. My first question is for Mr. Hanson.

In your statement you disagree with the FAA regarding the number of UAS near-miss reports with the FAA, that are received by the FAA. Does AMA have a data collection and analysis program underway to collect near-miss reports from UAS users or airline pilots? And how does AMA substantiate your statement, that the number of reports are actually much lower?

Mr. HANSON. No, ma'am. AMA does not collect that data. We use FAA's list of pilot-reported and individually reported sightings of unmanned aircraft. And I think it is important to note that they didn't classify all of those as being what is termed "near misses," or "near midair collision." They were termed a very subjective term, as being "close calls." And, again, that is subjective and undefined. And, to my knowledge, the FAA currently does not have a defined definition or a definitive definition of a near miss of a manned aircraft with an unmanned aircraft.

So what we did in our analysis was to go strictly to the language in the sighting itself, and only pull out those ones, or looked at those ones where the person reporting the sighting, in their determination, called it either a near miss or indicated they had to take some type of evasive action.

Quite honestly, there is a large number of the sightings in there that couldn't even be termed a "near encounter" of any kind, because it wasn't even identified clearly as being an aircraft.

Mrs. KIRKPATRICK. Do you have a suggestion for a definition of "near miss," then, that should be standardized?

Mr. HANSON. Well, if we are talking about a near miss between an unmanned aircraft and a manned aircraft, I believe that, before you create that definition, you will need to do some analysis of the environment that they operate in, and the types of vehicles that we are talking about.

As the captain cited, we are talking about very slow moving, very small objects, that, when seen from the cockpit, it is very difficult to give it any type of relative value, in terms of size, speed, and even its intentions, in terms of where it is going to fly. So I think there needs to be some study done in terms of what actually would constitute a near miss, and that is probably more from the perspective of the pilot, in terms of when and where and how he would be able to identify that object and to appropriately take action to make sure there is not any type of airspace conflict.

Mrs. KIRKPATRICK. I would agree with you. If we are going to develop some commonsense policy out of this committee, we need to have good data upon which to do that. So thank you for your suggestion.

My next question is for Mr. Hubbard. Mr. Hubbard, I represent one of the most forested districts in the country, although it is in Arizona. People don't think of Arizona as having that much forest.

I am sure you are very familiar with the horrific wildfires we have, and we are really trying to do something with prevention. And so my question is a little bit different from just suppression. You know, how—what is the opportunity to use drones in fire prevention, and in healthy forests?

Mr. HUBBARD. They are very useful, in terms of collecting the information and what we are dealing with on the land. So that kind of overflight to give us a good assessment of what is out there, without taking all the time and expense to go find out on the ground, is very helpful to us.

Mrs. KIRKPATRICK. And then, specifically, back to suppression, how do you intend to use UAS in fire suppression efforts?

Mr. HUBBARD. Well, primarily, the situational awareness, keeping track of what is going on, where our crews are on the ground, how the fire is behaving, and making sure that nobody is in harm's way unnecessarily, and that we can have the right kind of communications with those crews, in case they need to move, and move quickly. It gives us a lot of advance warning.

Mrs. KIRKPATRICK. You know, we had a tragic situation with the Yarnell fire, where our firefighting crew did not know the direction of that fire, and it changed dramatically from what was being expected. Would UAS have been helpful to prevent that tragedy?

Mr. HUBBARD. That is a difficult one to say. I would have liked to have had it available.

Mrs. KIRKPATRICK. Thank you. I yield back.

Mr. LOBIONDO. Mr. Farenthold?

Mr. FARENTHOLD. Thank you very much.

Mr. Canoll, you were talking about the need to register drones and enforcement and all. Would that be all drones, or are you just—is there some size limit, or some cutoff point at which you ought to be able to have a toy drone without having to turn your identity over to the Federal Government?

Mr. CANOLL. So it is an interesting question. And the way we approach it is more or less analyzing the capabilities of the vehicle, vis-a-vis altitude, range, speed, to see if they could actually end up in airspace shared with airliners.

Mr. FARENTHOLD. Like I can go on Amazon, and this is the best selling UAV [unmanned aerial vehicle], I guess, they have. It is $45.90. I can have it by Friday, because I am an Amazon Prime member, for free shipping. But the shipping weight is 1.1 pound.

Mr. CANOLL. Right.

Mr. FARENTHOLD. And it has a range of 50 meters. I mean that is 165 feet. You are surely not saying that needs to be registered.

Mr. CANOLL. If it can fly to 1,500, 2,000 feet, yes, sir.

Mr. FARENTHOLD. But if it only has a range of 50 meters, it is only going to get, what, 165 feet. So you are only——

Mr. CANOLL. I am not sure if that range is being expressed as a lateral range, or if that is the transmitter range or the actual physical capability. Following lost link at full throttle, would it just continue to climb to 2,000, 3,000 feet?

Mr. FARENTHOLD. OK, and let's go over to the FAA.

Mr. Whitaker, I have spoken to some folks in the UAV industry who have actually expressed an interest in working with you all on geofencing. Is there any way right now a UAV manufacturer can get a list of restricted airspace in a machine-readable format that they could integrate into their system?

Mr. WHITAKER. All of the information about airport airspace and restricted airspace is publicly available, and it is pushed out as part of the data that comes from FAA. And some of the manufacturers have already started to include geofencing technology in their products.

Mr. FARENTHOLD. So is there—so you are saying there is a standardized database that is updated regularly? I guess it is your Notice to Airmen?

Mr. WHITAKER. Yes, the charts are updated about every 2 months, sort of in a formal structure, and then, in the interim, there are NOTAMs [Notices to Airmen] that are put out to give interim updates.

Mr. FARENTHOLD. And do you have any idea—so you all are able to get that computerized, yet you are talking about the inability to keep a database of registered owners. I mean that seems pretty simple: name, address, manufacturer, model, and serial number. I mean I could probably code that, you know, before we finish lunch.

Mr. WHITAKER. Yes, sir. And then we need to verify that the person's name is the person who is actually registering it, which creates some of the complication.

Mr. FARENTHOLD. All right. And let's talk a little bit about—is there a way to integrate these affordably into the air traffic control system by putting some transponder or something on there where the air traffic controllers or the ADS–B and moving aircraft can see them?

Again, as this technology moves, it seems like you ought to be able to get that, basically, on a chip.

Mr. WHITAKER. So, with respect to amateur use, we really want to keep them out of the controlled airspace, if you will. So we want to keep them away from airports and under 400 feet, or, with the case of the small UAS rule, under 500 feet. I think there still is a question whether they shouldn't also be equipped with something that has a radio signal that allows us to track them otherwise.

When you get to the larger UAS, anything that operates in the controlled airspace would have to be equipped with ADS–B, the same as an aircraft would after 2020. But certainly that is going to be necessary to have any kind of integration in the larger UAS.

Mr. FARENTHOLD. All right. So, finally, let's talk for just one second about the difference between recreational users and commercial users. A lot of the recreational users like to stick a GoPro or some sort of camera on their drone. You then upload that to YouTube, and YouTube sells ads on them. And where do you cross the line into commercial use and private use?

Mr. WHITAKER. Well, I don't think the example you raised indicates commercial use. I think that is a pretty common use of recreational drones. Commercial use is if you are being paid to operate, or if it is being operated as part of your business model.

Mr. FARENTHOLD. I can just see there being, you know, being some potential gray areas there, you know. My——

Mr. WHITAKER. Always are, yes.

Mr. FARENTHOLD. My kids put a lemonade stand up and they post a video, a shot with the UAV of them selling lemonade at their lemonade stand, you potentially cross that line.

So I would just—my point is—and I would urge a light touch there for recreational users who really aren't being reckless. And, obviously, a lot of details there, and hopefully that is what some of your test centers that you are partnering with—universities, and the rulemaking processes are—but we have got to find the right balance between moving quickly, but not overregulating and killing a future industry.

I see my time has expired. Thank you.

Mr. WHITAKER. Thank you.

Mr. LOBIONDO. Ms. Brownley?

Ms. BROWNLEY. Thank you, Mr. Chairman. Mr. Whitaker, in my congressional district, in Ventura County in California, the sheriff's department is the only public agency that currently uses UAS, aside from the Navy—we have a big naval base there, and future home of the Triton on the west coast. But the sheriff's department has received a certificate of authorization to operate the device. They use it primarily for search and rescue. We have mountains in the district, so it is very helpful, from that perspective.

But every time the sheriff's office operates, they notify the nearby FAA air traffic control towers, and they also file a Notice to Airmen. And, as I understand it, that it not required, but they do it,

they take the step out of an abundance of caution. Is that something that you, the FAA, might consider in their rule, in terms of a requirement that people who are operating UAS would have to do—on a commercial basis, obviously?

Mr. WHITAKER. Yes, the public-use UAS are really quite mature, and operated in several ways that the small UAS won't be able to initially operate. The NOTAM system, I think, is an interim step to getting us to a more real-time ability to notify other users of the system. But that is, I think, the appropriate procedures at this time.

Ms. BROWNLEY. So, I wanted to ask a little bit more on the COAs [Certificates of Waiver or Authorization]. I think I read in the documents that there is close to 1,700 or so COAs that have been given. So what is the sort of—what is your backlog right now? What is the current demand?

Mr. WHITAKER. I am not sure what the actual backlog is. I can get that information for you. We have increased our throughput fairly dramatically, so that we are doing over 100 a week now. So we have cleared a lot of the backlog, but they are also coming in at a pretty good clip. So we can get those numbers to you.

Ms. BROWNLEY. So do you have any idea of how many UAS are being operated without a COA? Again, commercial applications.

Mr. WHITAKER. We don't have a way of knowing that, exactly. The indications that we are getting from pilot reports gives us some glimpse into what is happening without authorization. But the numbers are too big for us to track, and we don't have those resources.

Ms. BROWNLEY. And you said that there—you have now—for UAS over 400 feet, or I guess over 400 feet or under 400 feet——

Mr. WHITAKER. So for the——

Ms. BROWNLEY. It is a standard contract?

Mr. WHITAKER. For the model it is 400 feet, and under the small rule it will be 500 feet and below.

Ms. BROWNLEY. And so, can you give me a sense of how many of these COAs that you are involved in negotiating a special contract for specific use?

Mr. WHITAKER. So we try to group these COAs as much as possible, to expedite the processing. There have been 1,800 so far on the commercial side, and, literally, thousands on the public-use side. So these vehicles are actually in pretty widespread use now.

Ms. BROWNLEY. And you said only 20 or so civil penalties have been——

Mr. WHITAKER. We have had several hundred investigations. Under our compliance policy, our first preference is to get people operating in accordance with the rules. And if we don't have to use enforcement, we don't use enforcement.

There have been over 20 cases now that have required us to issue civil——

Ms. BROWNLEY. And what do those civil penalties look like? I mean what—can you describe what it——

Mr. WHITAKER. So the baseline is up to $25,000 per incident. In the case of the penalty that went out yesterday, it was $1.9 million. It involved dozens and dozens of flights over a heavily populated area.

Ms. BROWNLEY. So, in terms of wildfire suppression and the use of UAS, does the FAA have any specific legislative recommendations to improve the FAA enforcement authority, or to increase criminal or civil penalties for interference with wildfires?

Mr. WHITAKER. We are evaluating with other agencies the level of the penalties involved. Right now it is $25,000 on the civil side, up to $250,000 and 20 years in prison on the criminal side. That level is being evaluated, interagency.

The biggest challenge we have, we think the most bang for the buck comes from education, because a lot of the operations are inadvertent. And on the enforcement side, the real challenge is how we locate the operators of the vehicle.

Ms. BROWNLEY. And on the education piece, in terms of Know Before You Fly, the educational program, materials, is there any legal barrier that prevents the FAA from requiring manufacturers to include this safety information in packaging?

Mr. WHITAKER. We are prohibited from regulating for recreational-use drones. It is possible that we could do a rulemaking around that, but the timeframe of rulemakings is such it is not a particularly viable tool for us. So we are very much focused on voluntary compliance at this point.

Ms. BROWNLEY. I yield back, Mr. Chairman.

Mr. LOBIONDO. Thank you. Mr. Hanna?

Mr. HANNA. Thank you. As a pilot and someone who represents Griffiss Air Force Base, one of the six sites selected, I would suggest that there is more unanimity amongst you today than I have heard in a long time.

One of the problems is that we are probably a severe accident away from a public cry over why haven't we done something. Whereas, as Mr. Mica kind of implied, or said directly, Mr. Whitaker is off schedule, to be polite. And I would suggest there is urgency to this, as you know.

Mr. Canoll, you would have to agree that we are one accident away, I imagine, from something that people can't imagine that would create havoc, and be a rush to judgment about a whole lot of things that would affect Mr. Hanson's people. I have an 8-year-old son who owns three of these. If I bought him four more tomorrow, they would be wrecked by tomorrow night. They don't survive well, they are small.

But—and I don't see—I would say the Notice to Airmen is really—give the assumption that people have perfect information, that people call, investigate, do their homework. And I know, as a pilot, people do not.

I just—I wanted to ask you, Mr. Canoll, it is my kind of unconsidered opinion that these things do not belong near airports. And to that end, Mr. Hanson and Mr. Canoll, what kind of—and you have talked a lot about this in your statement, Mr. Canoll—is what kind of training do you think is appropriate that would—for the people that are flying these larger ones, or any one, if you will, that you would like to see?

Mr. CANOLL. Well, if the vehicle is intended to be operated in shared airspace, then I think the standard is very close to established, if not already established. And it exists for us, as a pilot,

to complete our training, recurrent training, and maintain all our qualifications.

If the vehicle isn't intended to operate in the airspace, then it is a matter of putting proper mitigations to keep it out of the airspace, be it from lost links, so the vehicle just doesn't fly off, or from unintentional blunders into the airspace. And that is the importance of the educational campaign that we all agree on up here.

One element of the educational campaign is we should consider testing, where someone goes online, reads the materials, and takes a little test. That satisfies the parents that the child knows how to operate the vehicle.

Mr. HANNA. What do you think about that, Mr. Hanson? I mean would you rather just stay out of airspace, pick a distance for different A, B, C, or whatever—you are not going to be in A airspace, but C or B airspace—do you accept what Mr. Canoll said, that you don't have—you should be in—you should have commercial training, or training as if a pilot, to fly in airspace that may have low ground levels near an airport?

Mr. HANSON. I think we take a little different approach to it. I mean we consider all airspace shared airspace. I mean the FAA claims their authority down to within 1 inch of the ground. So we instruct our pilots, and our educational program is based upon the fact that you—there is always the possibility of encountering a manned aircraft in that airspace. And we are to take every step necessary to not interfere with manned——

Mr. HANNA. But you have to admit that there is a lot more likelihood if you are on an airport than if you are not.

Mr. HANSON. Sure. And as we talk about flying in closer proximity to an airport, then we have other procedures that we put in place. But the primary safety tenets is to not interfere and to see and avoid at all times, and we have a very instructional document that talks about how a model aircraft operator should see and avoid.

And to the credit to the model aircraft community, there have not been significant airspace conflicts between true model aircraft and——

Mr. HANNA. Let me ask you this, though. Why is it important that you operate in the same airspace that would be an airport? Why does that—what drives you to think that? I am not saying you don't have a right to that, I am just curious why that is important.

Mr. HANSON. Well, I think it goes to the point that not all airports are created equal. We have a lot of very rural airports that have low traffic counts that are in communities where they are welcome to operate. We actually have clubs that are collocated on airports.

Mr. HANNA. I have seen many of them, yes.

Mr. HANSON. And they have—coordinating procedures allowing them to operate——

Mr. HANNA. So then, implying from that, you might—that would suggest to me that there are places where you would say you shouldn't be—maybe C and B space to the ground—and places where you could, where it is just general space in a grass strip in the middle of Cooperstown, New York, where I happen to fly out of once in a while.

Mr. HANSON. Well, there is no doubt there are locations where these types of devices shouldn't be flown.

Mr. HANNA. Yes, yes.

Mr. HANSON. It is not as easy an answer to say that you can't fly C, B——

Mr. HANNA. I guess what I am suggesting is that you have a lot in common here. And, rather than fight for something that is not reasonable, you may want to think about what is really important to the people who operate these things for agriculture and recreation at the types of airports that you just described.

Thank you, my time has expired.

Mr. LOBIONDO. The gentleman from California, Mr. Garamendi.

Mr. GARAMENDI. Thank you, Mr. Chairman and Ranking Member, thank you for the hearing, a very, very important one.

Mr. Larsen, you opened the issue of registration, and Mr. Farenthold picked it up, and I am—he mentioned picking up his smart phone at Amazon. It is registered. And most everything you buy today is registered, at least back to the manufacturer, in some way or another. It seems to me we don't need a Government registration program, but we need the Government to be able to access the registration program that the manufacturers probably already have.

It would be very simple to do that. Of course, we could spend several years trying to write a regulation to accomplish that, which is probably what we will do, because that is our specialty. Why don't we just simply say, "All of these UAS must be registered, held by the manufacturer or the seller of that, and the Government has the ability to access that under circumstances relating to an accident or some other incident"? Fairly simple, but probably far too simple for our normal workaround here.

The question was just raised about airspace at an airport. You know, we can go back and forth with trying to find what geofencing is, and wait 20 years for some sort of technology to actually work, or we can simply say, "Hey, if you are flying this UAS near a significant airport, a hub airport or a sub-hub airport, you are violating the law, and you are subject to a fine or even jail time. And, by the way, if you are flying near an active fire, you are subject to a fine and jail time." Now, that would immediately educate everybody involved in this sport or commercial activity.

Now, the other way around is study, study, study, which is the specialty of the Government, or those who don't want any interference by anybody.

So, anyway, I propose legislation introduced now, today—actually, yesterday—that simply says if you are flying a UAS within 2 miles of a significant airport, you are breaking the law, and you are subject to 1 year in jail and a significant fine. And if you are flying near an active fire, you are breaking the law and you are subject to 1 year in jail. Now, that is a pretty clear message.

So, Mr. Hubbard, what do you think of that, since you tend to fight fires?

Mr. HUBBARD. I think we need some help of some kind, because when we are fighting fire, we are at very low altitudes, and in very complex situations with a lot of distractions, not the least of which is smoke. So it is—the sense-and-avoid is very difficult. And if the

technology isn't there for the sense-and-avoid, then we have to turn to the education or to the regulation.

Mr. GARAMENDI. Mr. Canoll, Captain?

Mr. CANOLL. Yes, sir. I would love to see—I can't wait to read it, because I think it is a step in the right direction.

One concern would be with the limitation of 2 miles, assuming the reference point is in the middle of the airport, the threshold is 1 mile from that point, the vehicles could be well above me on approach to that airport at that point. Two miles, I am approximately 900 feet off the ground from the end of the runway. So I think it should be a little larger than that, especially at some of our larger airports. If you look at Class B airspace around Atlanta and in Miami, it drops all the way down to the surface as far as 6, 7 miles from the airport. We don't want anyone operating off the surface at all inside Class B airspace, unless they are talking to air traffic control and being controlled by air traffic control.

Mr. GARAMENDI. How about our little hobbyist?

Mr. HANSON. Well, it has been a long time since I have been called little, but the devil, I think, is always in the details.

Mr. GARAMENDI. Referring to the machines.

Mr. HANSON. I think the devil is always in the details. And, as the captain pointed out, at some airports 2 miles certainly might not be far enough. Other airports, it may be adequate or may be even too far.

I mean, if you were a homeowner within that distance, and you want to buy your—in my case—grandson one of these toys that can be flown in the backyard, I would hate to see him subject to a 1-year-in-jail penalty for flying it in his backyard. So I, like the captain, would be very interested in seeing the language of the proposed bill, and having an opportunity to comment on it.

Mr. GARAMENDI. Well, I will see that you have it in a few moments.

You know, we get really tied up in details here. And, in the meantime, as one or two of my colleagues have said, a time is going to pass, and the accident is going to happen. I will say the incident is going to happen; not sure it is an accident. But the incident is going to happen. We know that, in California, we have had numerous fires. We have also known in California that we are now facing a situation where those fires have expanded, as a result of drones shutting down the aerial operations. And we also had more than enough incidents in the airspace around airports, as was testified to.

So, I think it is time for us simply to lay down a marker here, and say, "If you are operating a UAS in these spaces, you are violating the law, and you are subject to a severe penalty." Now, that is the kind of education program that somebody might pay attention to. And if your grandchildren happen to be near that runway, and they are flying their little UAS that you kindly bought them that is somehow interfering with the approach of the captain into Atlanta airport, I am sorry, but the kid is breaking the law. And, as the responsible adult, you should also be held accountable, because we are talking about serious, very serious potential problems.

Yield back my time, and I will deliver a copy of the legislation to you.

Mr. LOBIONDO. Mr. Rokita?

Mr. ROKITA. Thank you, Chairman. Good morning, everyone. I appreciate your testimony.

Mr. Whitaker, it seems to me that folks in general aviation could work closely with drone operators and owners to help educate and train on these rules that are forthcoming, and different best practices for operations. Have you, as the FAA, reached out to any GA [general aviation] organizations or associations?

Mr. WHITAKER. I don't have specific examples of that. I agree, that that is an important aspect to this.

I think one of the things that we are looking at is this question of airspace, and how it is defined. Because right now the law——

Mr. ROKITA. That is not my question.

Mr. WHITAKER. I am sorry.

Mr. ROKITA. So you think it is a good idea. So will you—you will commit to reach out?

Mr. WHITAKER. Yes, sir.

Mr. ROKITA. OK. To who?

Mr. WHITAKER. To general aviation community——

Mr. ROKITA. Like who?

Mr. WHITAKER. Well, we usually work through AOPA [Aircraft Owners and Pilots Association] and small airport associations.

Mr. ROKITA. Would it—it is in your authority to reach out to them?

Mr. WHITAKER. Absolutely.

Mr. ROKITA. OK. So we will do that by what date, do you think? It doesn't necessarily have to be AOPA, but you say it is a good idea, I just want to get you on record when we can start moving to build partnerships where they make most sense. When can you do that by?

Mr. WHITAKER. If you would like, I can report back to you within 30 days on what—our plan to do that.

Mr. ROKITA. No, I—just tell us now when—you know, when you can make a phone call, when you can write a letter. When can you get these guys involved?

Mr. WHITAKER. Yes, in the next 4 weeks.

Mr. ROKITA. Great, thank you very much. Depending on the time of year, farmers may be out in the fields, wanting to use these machines. And I have—in Indiana there is farm operations 24/7, probably starting right now. And I think the proposed rule, 107.29, only allows day operations. Are you considering modifying that at all, or are you going to be strict on the day operations?

Mr. WHITAKER. The rule——

Mr. ROKITA. Because I could see, in a farm field, where it could be—these machines can be used all around the clock.

Mr. WHITAKER. So night operations is one of the areas that is being researched, and it could be allowed by exemption. But as soon as we can find ways to do that safely, that is something we would like to allow.

Mr. ROKITA. OK. I appreciate that.

Captain, thanks for your testimony, as well. How do your members know—when you talk about these near-miss sightings, and

these reports of UAS, how do you know it is what they saw versus, you know, a balloon that a kid let go a while ago, which I see in my aircraft from time to time—try to do a circle around it—safely, of course. Or even a UFO [unidentified flying object]. You can go on cable at night, anywhere from 11 o'clock to 3 o'clock in the morning, and hear all these pilots' stories about UFOs. How do we know we saw a UAS, and what specifically does ALPA do to verify the sightings?

Mr. CANOLL. So there is a redundant set of eyes in the cockpit. And, hopefully, both pilots can lay their eyes on the——

Mr. ROKITA. So all these reports are double sightings?

Mr. CANOLL. Not always, especially if the aircraft was only down one side of the aircraft for——

Mr. ROKITA. Right.

Mr. CANOLL. You may only get the captain or the first officer's——

Mr. ROKITA. Right.

Mr. CANOLL. And they are small vehicles, and they are moving quickly, we are moving quickly, they——

Mr. ROKITA. As your video depicts, it is hard to see these things. So how are we so sure—I mean, Mr. Whitaker, you were picked on by my good friend, John Mica, for only having 20 civil penalty cases. But, in all fairness, couldn't it be that you couldn't verify that these were even UAS to begin with?

Mr. CANOLL. You have to rely on the pilot's opinion of what he saw. We do see a lot of balloons.

Mr. ROKITA. But pilots aren't God.

Mr. CANOLL. No, sir. No one is asserting——

Mr. ROKITA. Right, so we shouldn't even necessarily on this panel or in America accept the premise that all these sightings or near-miss UAS sightings are really, in fact, UAS to begin with, should we?

Mr. CANOLL. No, sir, not all of them.

Mr. ROKITA. Right.

Mr. CANOLL. But many of them are in the——

Mr. ROKITA. How do you know how many, though? That is my——

Mr. CANOLL. I don't know how many, sir.

Mr. ROKITA. So we don't even know how many.

Mr. CANOLL. Quite a few more, and with the proliferation of the expansion to 1 million more of these, potentially, next year, even if a small percentage of them were UAS, I think we have a problem.

Mr. ROKITA. Well, that may be, but we don't know what we are talking about, because we can't even quantify it. There's millions of birds, too. Right?

Mr. CANOLL. I agree, that the fidelity——

Mr. ROKITA. That reminds me, Dr. Kochenderfer, you talk about Canadian geese being so much heavier. And the assumption in your testimony—at least something I took—is that birds are still certainly, or at least potentially, more dangerous. Yet the captain says, "Well, you know, there's metal batteries in these things, and they are dangerous, too." Can you elaborate on your testimony?

Dr. KOCHENDERFER. Yes, definitely. It depends entirely on the platform. I mean there are some drones that—there is one drone that came out last week that can fit on your fingertips, and weighs the same as three pennies. There are others, like the Phantom, that is one-third the weight of a Canada goose. There are others that have, like, a 10-foot wing span and weigh 30 pounds. So it really depends.

Mr. ROKITA. Yes, so you can't quantify it.

Dr. KOCHENDERFER. That is right.

Mr. ROKITA. And in the time I have remaining, I want to go into the commercial licensing structure, Captain Canoll. Your organization is recommending a commercial pilot's license, yet the flight characteristics of these drones, the stall characteristics, are completely different.

I have a commercial license, and it is basically a VFR ticket that is met with higher specifications. I don't understand why we need a commercial license. I am not getting that, and I am wanting to assume it is simply because you are worried about job protection, you are worried about the one day that these operators might—or these unmanned vehicles might take away a pilot's job.

Mr. CANOLL. No, sir, that is not the concern with the commercial operations. Operations for remuneration on all modes of transportation, be it a taxicab, an airplane, a sea-going vessel, all require commercial operations——

Mr. ROKITA. Right.

Mr. CANOLL [continuing]. And that is the basis of——

Mr. ROKITA. Because it is revenue-generating.

Mr. CANOLL. Correct.

Mr. ROKITA. So, in fact, you are worried about the revenue-generating impact of this, not necessarily the safety impact of this——

Mr. CANOLL. There is a higher expectation of safety when you pay for a service. Yes, sir. There is a safety element, as well.

Mr. ROKITA. Thank you. My time has expired.

Mr. LOBIONDO. Mr. Capuano?

Mr. CAPUANO. Thank you, Mr. Chairman. Thank you, gentlemen. I am not going to say anything you don't already know, so you can go to sleep, it doesn't much matter.

But to be perfectly honest, I just got off a plane. If a drone pulls down a plane that I am on, I guarantee you everybody you represent is going to get sued. And if you put me on a jury on a case like that, you are all going to lose. Because we can do something. Maybe it is not perfect yet. I am sure it is not, because this is a new and evolving technology.

But doing nothing in the face of a clear danger is not an excuse, to be perfectly honest. Getting it right over time, fine. But we should be doing stuff. Putting an educational packet—look, I own two drones. Not really big ones. I haven't got a clue what the heck I am doing with them, either. I really stink at it, which, of course, is a danger.

Now, I don't know about the 2-mile limit on the airport, I live within 2 miles of an airport, and probably a lot of my constituents live a lot closer than that. I don't know. I wouldn't intentionally try to bring down a plane, but Christmas presents, Christmas Day,

some kid doing something on a drone you can get out of Brookstone, nothing special. This is crazy.

We can do it on automobiles, we can do it on my phone. If I drop this phone today, right now, some very smart 15-year-old technology kid could figure out where I bought it, who it belongs to, where I was yesterday, who I called, et cetera, et cetera. Yet, if it happens to a drone, nobody knows. "Well, I saw something, I don't know what it was." Come on. You can put VIN numbers on it, you can put all kinds of wonderful, tiny little technology on it, even in something as small as your finger. And if you can't do it, I can—not me—I can find people who can do it, to be able to track it down.

Never mind the regulations. Now, I am all for those thoughtful regulations, thoughtful licensing. Not a problem. I am not trying to shut down the technology at all. I think this technology is opening up a wonderful new frontier, both for hobbyists and for professionals at all kinds of levels. But it also presents a danger, and that danger shouldn't be accepted. And just because it is difficult, doesn't mean we shouldn't do something.

So, I don't really have any questions, because I know you can do it. I just see a reluctance to do it, especially from the FAA. And I don't understand it. I don't understand it at all. Do something before somebody loses their life on this. I don't want to be here, yelling at you for having done nothing. That is no fun. And I certainly don't want to be yelling at you if it is somebody I know, and somebody I love, or somebody you know and somebody you love, or somebody in your profession. This is crazy. Just get it done.

Now, again, I understand it won't be the last item. I know that this is an evolving thing. I know that coming up with smaller things and bigger uses—and I am not so sure about the 2-mile radius, because there are some parts of a 2-mile radius that there's no planes at all. But I also know that there are some places beyond 2 miles that it does. So I am not sure what the answer is.

You guys know it. You already know it. I am not trying to involve myself, or trying to prohibit any hobbyist from doing anything that is reasonable and thoughtful. And I think that 99 percent of the people who are using these things are well intended, and just might make accidents. But accidents didn't stop us from putting VIN numbers on automobiles, on 15 different places on automobiles. Accidents happen.

But there are also some people that are bad people. And if there are bad people out there doing bad things, we haven't done anything that I know of to be able to allow us to find them. If somebody intentionally goes out to Logan International Airport tomorrow and sits in East Boston and flies a drone intentionally into a plane to kill somebody, we have allowed the technology to not exist. And it exists easily to be able to find that perpetrator. So you can have all the criminal prosecutions in the world. If you can't find them, it is not going to help. You can find my phone, you can find my automobile. Heck, for all I know, you can probably find my underwear. I don't know. But we can't find drone owners, because we haven't required a simple item to be installed. If you want to do size, do size.

By the way, at Logan we have a lot of geese. You can't control geese. But we chase them around. We get dogs to chase them around. They have a great time. We do something. Maybe there are better ways to do it, but we do something. Something is always better than nothing in the face of a known danger.

Like I said, I wasn't going to say anything you didn't already know, but thank you for listening.

Mr. LOBIONDO. Mr. Meadows?

Mr. MEADOWS. Thank you, Mr. Chairman.

Dr. K—I will call you Dr. K. Let me go to you.

Dr. KOCHENDERFER. That is what my students call me.

Mr. MEADOWS. Let me go to you. In your opening testimony you talked about midair collisions, and how the magnitude would be more significant in certain areas, and negligible in others. Can you elaborate a little bit more on that?

Coming from the rural area of western North Carolina, where you would assume most of it would be safe, but there's a number of small airstrips, grass strips, et cetera. So illuminate, if you would.

Dr. KOCHENDERFER. Yes. So when I was at Lincoln Laboratory, we got a stream of radar data from all of the FAA and DOD radars, and we estimated the density across the United States at different altitude layers, and so forth. And there are a lot of areas where we just didn't see anything in 9 months.

Mr. MEADOWS. So could we put forth certain counties where we have drone-free zones, or drone-permissible—are there certain counties across the country where there is relatively little if no chance of having interaction with an aircraft?

Dr. KOCHENDERFER. I guess that could be a——

Mr. MEADOWS. That is a loaded question, so go ahead.

Dr. KOCHENDERFER. It depends so much upon the altitude, right?

Mr. MEADOWS. Yes.

Dr. KOCHENDERFER. So that has to be part of the figure.

I mean I wouldn't—even over rural North Dakota or whatever, you shouldn't be at 20,000 feet.

Mr. MEADOWS. All right. So let me go further, then. How would you classify "near miss"? What is your definition?

Dr. KOCHENDERFER. So I did a lot of collision risk estimation for TCAS. TCAS was mentioned earlier. It is a collision avoidance system for manned aircraft, and the FAA is working on a version for unmanned aircraft. And as part of that analysis, we used a definition of 500 feet laterally, and 100 feet vertically. So that is for manned aircraft.

And there is nothing magical about this definition, it is just what——

Mr. MEADOWS. So, Captain, would you agree with that definition of "near miss"? Is that satisfactory?

Mr. CANOLL. Currently there exists a criteria for a near-miss report.

Mr. MEADOWS. Yes, I am talking about his definition. Would that be satisfactory to the airline pilots?

Mr. CANOLL. I don't believe so, sir, because it doesn't provide any—near what we would need to avoid the collision.

Mr. MEADOWS. Can you get to the chairman of this committee what you would estimate a near miss would be, and——

Mr. CANOLL. I am not sure we are equipped to do that analysis, sir. But we can——

Mr. MEADOWS. Well, can you query your pilots and ask them to opine on it? How about that?

Mr. CANOLL. Yes, sir. We can ask——

Mr. MEADOWS. OK.

Mr. CANOLL [continuing]. And gather as much information as possible.

Mr. MEADOWS. Let me go real quickly and finish up.

Mr. Whitaker, some have suggested that your rulemaking has not been expeditious. And I believe, in your earlier testimony here, when you were talking about doing a rulemaking for commercial drones, when—I guess you said the commercial viability and economic viability increases. Did I hear you correctly on that?

Mr. WHITAKER. I think the question was around large UAS.

Mr. MEADOWS. Right.

Mr. WHITAKER. Yes.

Mr. MEADOWS. And that you would—so there is a certain mentality that says if you build it they will come. And your testimony here today is if they build it we will regulate it?

Mr. WHITAKER. No. We are trying to move in step with both the commercial demand and the technology.

Mr. MEADOWS. But, Mr. Whitaker, let me suggest that you are more forward-thinking in terms of regulations. The ambiguity of FAA doing nothing creates the kind of dynamics that we have here today, both on the commercial and on the hobby side of things. And the more finite you can be, the better that commercial activity will be, in terms of meeting your expectation. If we wait until—to draw the regulations until we have problems, as we are trying to do today, it creates much uncertainty in the market. Wouldn't you agree with that?

Mr. WHITAKER. Yes, sir.

Mr. MEADOWS. So how do we best move your rulemaking faster, as it relates to the near misses that we are talking about here, and allow us to compete in drones? Because if not, if—we are going to lose out to the drone technology in Europe. We have had other testimony sitting at that very table that would suggest that. So how do we make sure that you are nimble and do that effectively?

And I am out of time, so I will yield back, and——

Mr. WHITAKER. Thank you.

Mr. WOODALL [presiding]. The gentleman yields back. The Chair recognizes the gentlelady from Nevada, Ms. Titus.

Ms. TITUS. Thank you, Mr. Chairman. I believe that FAA has a definition of "near miss" that is already in regulation that is a lot larger than what the professor mentioned. But, anyway, we can check that out.

I would like to direct my comments to the Administrator. But if any of the rest of you want to weigh in, I would appreciate that.

You know, I represent Las Vegas. And I was a strong proponent of Nevada being named one of the original test centers for this kind of technology. And you mentioned that they are there for collaboration and research. But what seems to have happened is that these

test sites have kind of fizzled out. There is not a lot of attention there, they kind of don't know what their goal is, what they should be doing. I would like to get you to comment on that.

What can these test sites be doing, what is the FAA doing to encourage and support them? Seems like the FAA has now got all its attention on granting these section 333 exceptions, as opposed to working with the test sites. What is the point of them now? If you would, address that.

And I would also ask you that when they grant these exceptions, do you continue to get information from these facilities that now can fly? And how do you use that information to inform this process of regulation development? Or is that just once they get the exception they are out there, and we don't know what is going on?

Mr. WHITAKER. Yes, ma'am. The test sites, the six test sites, are designed to provide an infrastructure for testing, so that the private sector can use them, and other researchers can use them for flight tests and other testing. We have tried to streamline the approval process to a large degree, which I think we have done.

But at the same time, they are also designed to be a marketplace. So they have to compete for that work. And some test sites have been more successful than others in that. We have been meeting with all the test sites over the last 2 months to try to help jump-start and facilitate some of that work.

To your second point, the tech center has a role in accumulating the data from the test site operations and collating that data and using it for supporting our research efforts.

Ms. TITUS. Anybody else care to comment on whether these test sites are working like they should, or we are getting enough information from them, or they don't make much difference?

Mr. CANOLL. Well, I think industry, ma'am, as they start to see the value of the test site—because, while I am not a technician, I am not a designer, but the company that comes up with a small, lightweight, universally powered active collision avoidance system that is priced at a point that can be placed on almost any aerial system, that company is going to make a lot of money. And their best place to test these are the existing test sites. So I think it is a good program, moving forward.

Ms. TITUS. I would like to go back to the Administrator. Part of my question was about granting all the section 333 exemptions. That seems to be where most of your energy and effort is concentrated now, instead of supporting technology and testing and data collection. Is that accurate, or——

Mr. WHITAKER. Well, I would say those are different functions. And the section 333 has certainly gotten a lot of attention, but it is a different group, if you will, within FAA that does that. We have research going on with MITRE Corporation, with—in conjunction with NASA, DOD, at the tech center, and at the Center of Excellence. So we are focused on all of those things, and they are all part of the puzzle, going forward.

Ms. TITUS. So do you get information back after you have granted an exemption to one of these companies, or——

Mr. WHITAKER. Not necessarily for commercial exemptions, although we do have some commercial partnerships, where we are taking that data and analyzing it.

Ms. TITUS. Wouldn't that be helpful for making up these regulations?

Mr. WHITAKER. Well, it is not a restriction. We have issued 1,800 333 exemptions. It is not a restriction that we feel is appropriate for commercial operators to mandate that type of work.

Ms. TITUS. So you don't think it would be helpful to find out what these——

Mr. WHITAKER. It might be helpful in some that are willing to do that that we have partnered with.

Ms. TITUS. So it is voluntary?

Mr. WHITAKER. That is correct.

Ms. TITUS. And if you look at the way the agency is set up, is there more priority, more effort, more energy put in to granting these exceptions than in the testing and the technology and the test centers?

Mr. WHITAKER. No, I would say they are not linked. And as the small rule gets finalized, that 333 process will be dramatically reduced.

Ms. TITUS. Well, if the—but they are—shouldn't they be linked? You are the one who used the term "collaboration" about the test sites. Shouldn't——

Mr. WHITAKER. Well, they are linked as far as exchange of information. But the 333 approval process is a different workforce than the research coordination.

Ms. TITUS. Right. But isn't that where the priority is now, instead of on the testing and getting the information to make these regulations?

Mr. WHITAKER. The priority would be on both of those.

Ms. TITUS. How do you measure that?

Mr. WHITAKER. Well, we measure the 333s by throughput. And on the test sites and the research, it is not amenable to immediate sort of metric measurements. But there is a lot of research, a lot of effort going into that.

Ms. TITUS. OK. Thank you.

Mr. WOODALL. The gentlelady yields back. The Chair recognizes the gentleman from South Carolina, Mr. Sanford.

Mr. SANFORD. Thank you, Chairman. It strikes me, I guess, three things hit me: one, the unmanned is the—if it is not the future of flight, it is certainly the next frontier of flight; two, that there has been a long-time fascination with flight, going back to the days of da Vinci, and moving forward to the Wright Brothers; and three, that we want to encourage innovation on that front. And, in general, Government regulation control and other inhibits that innovation that I think is vital, ultimately, to American competitiveness.

So, we want to have, you know, kids out there, fiddling with something. You say, "Well, if you tie these three rocks onto it, will it fly as well?" I mean, you know, at the base level, kids in the basement of a garage working with some of this stuff may well lead to innovations and new developments with regard to unmanned flight that, I think, could have commercial applications, and certainly competitive applications.

And so, you know, what has hit me in sort of listening to testimony today is, you know, how do we get to a place that is minimally invasive, with regard to unmanned, and how do we get to a

place that keeps Government out of involvement as much as possible, so that we maximize individual freedom without in any way interrupting commercial flight or noncommercial flight.

And so, I was intrigued by what my colleague from California had gotten at, and my colleague from North Carolina. How do we come up with something that is really simple, whether that is the kind of legislation you talked about, so that you don't end up with a bunch of, you know, things being tacked on to this equipment that raises the price, that keeps, frankly, many consumers out of the marketplace? How do you keep up with some massive database? And then we got to hire more bureaucrats to cover the database, watch the 90 percent of folks who wouldn't be a problem. How do we do something quite simple, whether that is the Garamendi language, or something else?

And I guess I would begin with you. Any ideas from your end, Doctor, on something that you may have seen in a different country as a best practice, or something that you may have heard about in talking with other colleagues that would, indeed, be minimally invasive?

Dr. KOCHENDERFER. Yes. So I think an altitude limit is minimally invasive. Very easy to implement. That is something that we can do now.

Mr. SANFORD. But if I understand it right, it wouldn't solve the problem of, you know, you go to 400 feet, but if you are 400 feet off final, then you got a problem.

Dr. KOCHENDERFER. Yes. So, I mean, trying to solve the whole problem is very complicated, and will take time. Four hundred feet is something that——

Mr. SANFORD. OK, that would be your vote.

Dr. KOCHENDERFER. Yes.

Mr. SANFORD. Let's just—we will keep it moving. Mr. Hanson, your thought? Quick thought. Most simple remedy would be what?

Mr. HANSON. I believe that the community-based approach has proven, for decades, to be an effective way of handling at least the model aircraft/hobby environment, and I would look to that to continue keeping this operation——

Mr. SANFORD. Community-based model. Captain Canoll?

Mr. CANOLL. So outside of the community base, those who are operating outside of that, the altitude restriction would help. But also, if there was a way to restrict the enabling of the vehicle when you purchase it until a code is put in—you need to get that code, you have to go online and pass a test, and now you know, "Oh, that is right, I can't go to the airport, because I couldn't get my code without passing the test."

Mr. SANFORD. Code. Mr. Hubbard?

Mr. HUBBARD. Until technology catches up, public awareness.

Mr. SANFORD. Mr. Whitaker?

Mr. WHITAKER. I would say the most efficient way to get there is an industry-based standard, so we don't have to go down the regulatory path. And that involves stakeholder engagement, which we are also focused on.

Mr. SANFORD. I very much like that idea of industry standard versus Government edict.

One quick question, because I see I am down to 52 seconds. And I guess this would be directed to you, Mr. Hanson. Going back to that idea of industry standard, how would you describe the way in which AMA develops and educates its members and the general public about certain modeling guidelines and safety at large?

You know, you talk about community standard, you talk about sort of industry standard. How do you all do that, presently?

Mr. HANSON. Well, currently, within our membership we—a lot, if not the majority, of our education is done at the local club level, with the club—the local people come together and gather in a club and share information.

In terms of the broader membership, we do that through our mainstay magazine, through our online presence. And then, in terms of the uneducated consumer, we are doing that through the Know Before You Fly campaign.

Mr. SANFORD. I see I have 1 second left, Mr. Chairman. Well, down to zero.

Mr. WOODALL. Thank you for yielding back that second, Mr. Sanford. The Chair recognizes the gentleman from Washington, Mr. Larsen.

Mr. LARSEN. Thank you, Mr. Chairman.

Deputy Chief Hubbard, in your testimony you said the Forest Service and the Department of the Interior are developing a summary of the 2015 field season, and you will make recommendations. When could we expect to see that summary?

Mr. HUBBARD. The summary of the incursions?

Mr. LARSEN. Yes.

Mr. HUBBARD. Yes, we have that available now.

Mr. LARSEN. Oh, OK, all right. It is available now. Are you making recommendations from that summary?

Mr. HUBBARD. No, that is just capturing what we have encountered. And we turn to FAA and others for recommendations.

Mr. LARSEN. So one of the instances in California you reported that five aircraft were delayed for 20 minutes. Is that right?

Mr. HUBBARD. Yes.

Mr. LARSEN. Yes. What impact can a 20-minute delay have on your ability to contain or suppress a fire? What happens in 20 minutes?

Mr. HUBBARD. In back-country fires, not a lot. It gets bigger. In interface fires, where you have life and property at risk, it, of course, depends on the situation. But it could be dramatic.

Mr. LARSEN. Define dramatic.

Mr. HUBBARD. Loss of property, for sure. And sometimes putting lives at risk.

Mr. LARSEN. Yes, yes. So, after we get a chance to review the summary, I may do some followup with you on—just to understand better what steps we might take.

So then, FAA and you all have worked on it. Do you have an MOU [memorandum of understanding]? Is that right, or an MOA [memorandum of agreement]?

Mr. HUBBARD. MOA, yes.

Mr. LARSEN. An MOA. And what is in that MOA?

Mr. HUBBARD. How we would want to proceed together to try to resolve these kinds of issues, because we know we are an outlier,

in terms of our statistics and our operating altitudes. And it is going to be a little more complicated. So we need some help.

Mr. LARSEN. How many millions of acres did you say were on fire in the West this year?

Mr. HUBBARD. We burned 9 million acres.

Mr. LARSEN. Nine million? What was the other number that you had? I mean how many individual fires were there?

Mr. HUBBARD. 47,000 fires.

Mr. LARSEN. Is that an outlier?

Mr. HUBBARD. No.

Mr. LARSEN. So I don't think you are an outlier. I don't think so.

Mr. Whitaker, how do you confirm that there have been situations where drones have come inappropriately close to aircraft? There's been some questions about confirming these, whether they are or they aren't. How does the FAA come around and confirm these?

Mr. WHITAKER. Well, I think, as others have discussed, they are difficult to confirm. We don't have numbers on these things that we can see, we don't have an ability to locate them the way we would with a laser, for example. And that is just the nature of the data. So it is very raw data.

I think what we can say is that the trend in the data is pretty obvious. So the number reports on a monthly basis now is over 100, and that is a fivefold increase from a year ago. So you can argue around the margins, but I don't think there is any question that there is a significant trend.

Mr. LARSEN. Yes, yes. And Captain Canoll, how do you confirm? How does ALPA confirm these numbers?

Mr. CANOLL. Well, it is—the information we get is on an anecdotal basis, and then we point our members to the Web site, which helps them refresh their memory on the criteria for a near midair collision report.

Mr. LARSEN. Oh.

Mr. CANOLL. And then, if, in their mind—which is the determinative factor in this instance—they believe they had one, we point them to the various links at the FAA, so they can fill the form out and submit the report. That is beyond the report that happens real time, where the pilot says, "Hey, there's one of those X-wing drones," presses the button on his transponder, and calls the tower or the approach control, and says, "I just observed this," and then the controller can say, "OK, that is a data point for us."

Mr. LARSEN. Yes.

Mr. CANOLL. And can warn the aircraft behind them. That is very important.

Mr. LARSEN. Yes, right.

And, Dr. K, you are the technology guy. How would you suggest we clean that up? How to confirm these——

Dr. KOCHENDERFER. Yes, it is really tough if you just rely upon pilot reports. And I don't want to diminish the severity of this, but there have been, well, at least one case where the pilot thought they hit a drone, and it turned out later to be a bird. So it is very tricky.

So what you would have to rely upon is some kind of surveillance system, perhaps something near an airport that could actually capture these things.

Mr. LARSEN. Yes, yes. And can you talk a little bit, as well, about—and this will be my final question, I just want to understand, without getting into the deep, gory details, but the difference between an engine taking in a bird, and an engine taking in either a composite material drone, or a drone that is metal-based.

Dr. KOCHENDERFER. Yes. So, I should clarify that engine ingestion is not my area of expertise, but I have talked with some people, and we don't really know. And I was very happy to hear that the FAA is pursuing that. But, I mean, it is not rocket science. It has probably something to do with the size of the drone, the components it is made out of, and so forth.

Mr. LARSEN. Sure. So we will think about that. Thank you, Mr. Chairman.

Mr. WOODALL. The gentleman yields back. The Chair recognizes the gentleman from Illinois, Mr. Davis.

Mr. DAVIS. It is always tough to follow my colleague talking about engine digestion or ingestion or indigestion. So great question, Mr. Larsen.

Hey, thank you for being here. I apologize. Multiple hearings today, so if I am redundant with any of my questions, please forgive me. But I have a concern. I represent central Illinois, home to some of the manufacturers of our newer types of hobby aircraft in UAV technology, and also home to many possible users of this technology for commercial use.

And I know a lot of discussion was on the exemption program that is currently being implemented and run through the FAA. And part of my concerns have to do with some previous hearings like this, where we talked about the exemption process moving very slowly to offer commercial exemptions to those who have applied. And now, since they have sped up, what we have seen is some of the older requests being limited versus some of the newer requests in what can be done with the technology for which they have applied for the exemption.

And Mr. Whitaker, I appreciate that your process has evolved at the FAA, but I think there is—there might be a concern where older applicants and older exemptions that were issued may need to have some of the newer flexibility that some of the newer exemptions that are being issued currently enjoy.

So, can you tell me? Is there a process in place at the FAA right now to look at some of the older applications to see if they need that same type of flexibility? And, if so, are you going to do that unilaterally, or is that something that the previous applicants have to do?

Mr. WHITAKER. So this is not a concern that I have heard expressed before, but it sounds like a concern that the newer exemptions have more flexibility. That would normally be triggered by the current holders coming back for some adjustment to their 333 application. But I——

Mr. DAVIS. So they would have to come back personally to change the operational conditions that they——

Mr. WHITAKER. As opposed to us changing the conditions for them. But I will look into that and respond to your office——

Mr. DAVIS. Well, please do. It is a concern of those in my district——

Mr. WHITAKER. Yes.

Mr. DAVIS [continuing]. Who have been possibly granted exemptions that may now be outdated.

Mr. WHITAKER. Yes.

Mr. DAVIS. And I do believe—and I hope that you take this back—that we need to have some flexibility in that process, because the technology has changed, even over the time that this program, this exemption program, was implemented.

Mr. WHITAKER. Absolutely.

Mr. DAVIS. And the technology that is being produced in my district is going to continue to evolve unless we, the Federal Government, stop its ability to evolve and to continue to grow into what I think should be commercial usage, and a much more flexible commercial usage for UAV technology, and to do it in a safe way. But I don't think—I think that can happen.

And while I have time left, I will not butcher your name like—my colleague, Mr. Larsen, didn't either, since I wasn't here to get the correct pronunciation. I will call you Dr. K again, too.

Dr. KOCHENDERFER. That is just fine.

Mr. DAVIS. Can you give me an idea of how maybe transponder technology could be helpful in avoiding some of the collisions, some of the issues that I think the FAA is facing right now, and we are, too, as policymakers?

Dr. KOCHENDERFER. Yes. So if unmanned aircraft are going to be flying at the level of transport aircraft, or even up with general aviation aircraft, in order to be seen by TCAS and so forth, they need to have some kind of transponder.

Mr. DAVIS. Doesn't that transponder technology work at lower level flights, like life flights?

Dr. KOCHENDERFER. It could work, as well. I am not sure how many life flight helicopters have TCAS installed. But it is a possibility.

The problem, though, is that the cost of these transponders, including ADS–B Out, is pretty expensive. And they consume power and they are heavy. So for a lot of these larger aircraft, it makes sense, and should be absolutely required. But for smaller drones, maybe a couple pounds——

Mr. DAVIS. So the technology for lightweight transponder technology does not currently exist for the newer versions of UAV. Right?

Dr. KOCHENDERFER. There is a lot of interest in actually developing this, and this is an activity of Google, in fact.

Mr. DAVIS. An entrepreneur's dream, or an entrepreneurial dream.

Dr. KOCHENDERFER. Yes.

Mr. DAVIS. And how do you pronounce your last name, since I don't have any more time?

Dr. KOCHENDERFER. It is Kochenderfer.

Mr. DAVIS. Thank you. I yield back.

Mr. WOODALL. The gentleman yields back. I recognize myself for just a few moments.

Mr. Whitaker, you talked about the difference between going after folks with serious penalties when they did not learn their lesson, versus trying to train folks up. I am thinking about the number of incursions on restricted airspace by licensed pilots, by trained pilots, by pilots flying planes with transponders. I see those incursions in restricted airspace listed in the thousands. Do you happen to know how many of those folks have faced serious penalties, versus just trying to be trained up?

Mr. WHITAKER. So you are talking about incursion between manned aircraft?

Mr. WOODALL. That is right.

Mr. WHITAKER. Yes, I don't have statistics on that. Our compliance philosophy would largely be the same, that we would be focused on remediating the problem and making sure there is compliance as a first step, before moving to enforcement.

Mr. WOODALL. I am told the maximum financial penalty for one of those restricted airspace incursions is $1,100. I think Mr. Mica from Florida has legislation to increase that to $100,000. But I just want to contrast that for a moment with what we are talking about with unmanned vehicles today.

Captain, you are one of my bosses, so I take you at your word when you tell me how we can solve problems. But I have heard a lot about adding technology to these $55 drones to keep them out of restricted airspace, yet no one is making that same suggestion for $50,000, $100,000, $150,000 manned aircraft.

Is the importance of keeping folks out of restricted airspace such that, before we start talking about adding technology to $55 drones we should be adding it to $55,000 aircraft?

Mr. CANOLL. So I think it is a multilayered problem. And it is not only the financial penalties for manned aircraft. Straying into restricted airspace will ultimately result in you losing your license to operate the aircraft.

And tracking who is the operator of the unmanned aerial system is difficult. So that is where part of the conflict is. I think we have to look at it—both.

And, you know, I don't know the numbers, either. But I do know we have programs in the manned aircraft community, such as ASAP [Aviation Safety Action Program], where if you make a mistake in an aircraft—we are human, and we do make mistakes—you have a way of reporting it. And that report is gathered into a very large database. And we can do analysis on it. That, to my knowledge, doesn't exist for the commercial operation of unmanned systems. Yet I think it would be a good idea for us to look at it.

Mr. WOODALL. Having that reporting database might be the more powerful, as a dictator of behavior, than having some of these technological restrictions across the board.

Mr. CANOLL. I think they are both important. But to have the database of someone who could voluntarily report, "Hey, I lost command of my vehicle for this amount of time, and I think it was because of this," then we can look towards mitigations for the problems that they experienced in the future.

Mr. WOODALL. Doctor, you suggested that—in response to one of my colleague's questions—that one of the easy answers would be an altitude restriction. My guess is we are either going to have to change the strength of the transmitter, or put an altimeter in every unmanned aircraft to make that effective.

Is that what you had in mind, a technology solution to create an altitude restriction, not just a rule that then would be left up to individuals about whether they abided by it or not?

Dr. KOCHENDERFER. Yes, I think that something should be enabled by default. Because, like I said, when you pull it out from underneath the Christmas tree, a lot of people just try to see how high they can go. And we really want to prevent things like that.

But it should be allowed to be overriden, because a lot of these consumer drones are used by legitimate operators, like law enforcement and so forth.

Mr. WOODALL. Well, that was, in fact, the very first line of the captain's written testimony, is this is obviously an industry that has great benefit potential for America, for quality of life, for safety of pilots, and how can we come together on that.

I will close with this, then. I would ask each one of you. In the context of terrorism, I can tell you there are an unlimited number of folks who want to do us harm. I am sorry, an unlimited number of ways to do us harm, but a limited number of folks who want to do it. In this area that we are talking about today, unlimited number of ways that accidents can happen by untrained personnel, a limited number of folks who really are out there, day in and day out, to violate the rules, as the FAA has indicated just this week.

Is that the challenge, Doctor, not to find a one-size-fits-all aircraft solution, but to go after those folks who would intentionally violate the—whether it be industry standards or Federal regulatory standards?

Dr. KOCHENDERFER. In my written statement I categorize the different kinds of users. So I worry a lot about the naive users and the reckless users. I think bad actors are a separate category, and I would have to say that there is relatively little we can do about that right now.

Mr. WOODALL. Mr. Hanson, should we be focused on the naive users or the bad actors?

Mr. HANSON. Well, I think intentional acts need to be dealt with, and I think there are existing laws and sanctions that could be put in place to do that.

The naive, or the uneducated community is one that we really need to focus on, because we firmly believe—and our experience shows us—that the users, if good-natured and conscientious individuals, they just need the proper information.

Mr. WOODALL. I thank you. If there are no further questions, then I thank all of the witnesses for their testimony and their indulgence today, and the committee stands adjourned.

[Whereupon, at 12:13 p.m., the subcommittee was adjourned.]

STATEMENT OF MICHAEL WHITAKER, DEPUTY ADMINISTRATOR OF THE FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE, SUBCOMMITTEE ON AVIATION ON ENSURING AVIATION SAFETY IN THE ERA OF UNMANNED AIRCRAFT SYSTEMS, OCTOBER 7, 2015.

Chairman LoBiondo, Congressman Larsen, Members of the Subcommittee:

I am pleased to appear before you today to discuss a subject that continues to be the topic of a lot of conversation; Unmanned Aircraft Systems or UAS. Wherever we look, in everything from popular culture to store shelves, UAS seem to be everywhere. It might appear to some people that UAS suddenly appeared in our skies and are now everywhere, from the White House lawn to the U.S. Open Tennis tournament, sometimes flying too close to commercial aircraft or interfering with firefighting efforts. Many different departments and agencies within the federal government have responsibilities associated with UAS. Among other things, the Federal Aviation Administration's (FAA) responsibility includes the safe and efficient integration of UAS into the National Airspace System (NAS). In 2012, Congress passed the FAA Modernization and Reform Act of 2012 (2012 Act), which, in part, charged the FAA with safely integrating UAS into the NAS by September 30, 2015.

FAA has recognized the significance of this technology and has adapted organizationally to provide this emerging technology with a commensurate level of attention. Recently, FAA selected two executives to oversee our UAS integration efforts. Accompanying me today are Marke "Hoot" Gibson and Earl Lawrence. Hoot is the Senior Advisor on UAS integration, reporting directly to me. He will establish a focus on external outreach and education and interagency initiatives. Earl is the Director of the UAS Integration Office within the FAA's Safety organization. He will lead the FAA's efforts to safely and effectively integrate UAS into

the NAS. Their addition to the FAA team acknowledges the expanded demand of UAS issues both inside and outside the FAA.

There is no doubt that UAS can be of great value to this country. In accordance with the appropriate authorizations, UAS are being used today to examine infrastructure, survey agriculture, provide emergency response support, examine damage caused by time or disaster, and go places that would otherwise be dangerous for people or other vehicles. Entrepreneurs around the world are exploring innovative ways to incorporate the potential of UAS into their corporate activities. There are a number of public and commercial operations being conducted today, including the ones mentioned above, that contribute to public safety and enhance the ability of corporations to achieve important goals. FAA does not underestimate the importance of integrating the range of UAS technology into the NAS, but there are significant safety challenges that must be mitigated for this to occur.

For example, we have witnessed a huge influx of casual users, people who fly UAS for entertainment or recreation. This has become the crux of a growing problem. UAS introduces, not just a new class of aircraft, but a new class of pilot. The vast majority of these operators do not have the basic aviation training or experience required for pilots of traditional aircraft. They have no knowledge that they may be flying in controlled airspace. Some may have no recognition that their actions could have serious consequences. They are simply having fun with a toy.

The primary goal of the FAA is to integrate this new class of aircraft and their operators safely and efficiently into the NAS, regardless of whether the operations are recreational or commercial in nature. Because this new branch of aviation is changing at the pace of human imagination, the

FAA believes a flexible framework is imperative. The UAS industry is developing many new exciting technologies and the FAA must provide a regulatory framework for UAS to operate safely. Our goal is to provide the basic rules for operators, not identify specific technological solutions that could quickly become outdated. The FAA is creating a safe operational environment for innovators to demonstrate their technologies. We are doing this through the establishment of basic operational regulations, the issuance of exemptions and experimental certificates, and through our continued research and collaboration at our UAS test sites, Center for Excellence, and Pathfinder programs.

Our efforts also include long-term planning, including the ongoing development and finalization of the regulation of small unmanned aircraft. We are conducting collaborative research and development with interagency partners and the UAS industry. We have established test sites and airspace for these activities. The FAA and our government partners have always realized that the best way to succeed is through partnership, whether it be with industry or other governments. Finding consensus leads to cooperation and willing participation.

Consistent with our approach to other regulations, we are establishing a risk-based approach to the regulations in this area, laying a strong foundation for safe integration. The concept is balance. We must develop a broadly scoped approach to rulemaking to identify and mitigate safety risks without stifling innovation and industry performance. However, a key factor in the success of any regulation is the willingness of the operators to follow them.

Integrating UAS means integrating operators into the aviation culture and mindset. It means creating a general awareness that these devices are not toys and the consequences of misuse can be serious. We believe the most effective way to accomplish this task is through education. We

want to work through partnerships with model aircraft organizations, manufacturers, and interagency partners, as well through traditional and social media outreach, to ensure that these new operators know when and where they may safely fly.

To this end, with the help of our stakeholders, we developed the "Know Before You Fly" and "No Drone Zone" programs. "Know Before You Fly" offers common sense advice, such as don't fly near airports, don't fly in adverse weather, don't fly under the influence of alcohol or drugs, and don't fly over people or sensitive infrastructure like power plants.

Our "No Drone Zone" program began with the Super Bowl earlier this year and is tailored to specific events and places, such as the heavily restricted airspace around Washington, D.C. The No Drone Zone video posted on You-Tube prior to the Super Bowl this year received over 59,000 hits. Most importantly, we received no reports of unauthorized activity in the restricted airspace around the stadium.

We want people to enjoy their hobby, but we want to make sure they fly safely. Education, such as the programs noted above, has been our preferred method for successfully integrating UAS operators. We can never let an educational opportunity slip by. We need to be creative and collaborative in our approach to reaching the public. I will share with you two examples of this approach. Several UAS manufacturers have started to voluntarily include the "Know Before You Fly" safety literature with their product packaging. We are also trying to reach a broader audience by working with the San Francisco 49ers NFL football team to use their scoreboard to make public service announcements during their games. We hope to expand this type of outreach in the coming months.

In order to make it easier for the operator to know when and where it is appropriate to operate a UAS, in particular a model aircraft, we helped develop the B4UFLY mobile app. This is a simple, intuitive user interface that lets the UAS operator know if there are any prohibitions in place for where they are flying or where they want to fly. There is a color-coded status indicator with text that provides the operator with situational awareness. Beta-testing of this app is ongoing and the FAA will make adjustments where necessary based on user feedback. The industry is clearly looking to FAA for leadership in educating the public about the safety parameters for model aircraft operations. Our vision for this app is that the FAA would continue to support the basic technology, while other companies could augment it with their navigational maps.

As discussed, the FAA believes that partnerships and education are the keys to the success of safe UAS integration. But to be clear, if the unauthorized operation is intentional or is intended to cause harm, strong and swift enforcement action, including criminal enforcement, will be taken.

When UAS delayed fire-fighting activities in the drought-stricken western states, local law enforcement and forest service personnel were on the front lines dealing with the situation. We are working with law enforcement agencies to educate them about our rules and to emphasize that, in addition to the FAA's rules, there are existing state and local laws in areas of reckless endangerment, trespass, and privacy that could apply. Just because this is a new technology or different than what law enforcement has seen in these areas before does not mean that these laws would not be equally applicable to such acts involving use of UAS. We want to work with law enforcement because if they encounter unauthorized UAS operations, they can help us to gather evidence and find witnesses that will help with our investigations and enforcement action. For

some, education will never be sufficient. As with any other activity, we will always have to contend with those who wish to cause mischief or refuse to consider the potential harm their activities might pose to others.

Informing and educating UAS operators is just one piece of integrating these vehicles safely into the NAS. The 2012 Act provided the Secretary with the authority to issue exemptions that allow for commercial UAS activity in low risk, controlled environments (section 333 exemptions). After gaining experience with various types of operators, the Department recently expedited its approach for section 333 exemptions. We are now able to issue summary grants when we find that we've already granted a similar exemption. Summary grants are more efficient because they do not require applicants to repeat analysis that has already been performed. This streamlined approach now allows the Department to issue between 40 and 50 section 333 exemptions a week. These exemptions are effectively acting as a bridge until the small UAS rule comes out to more broadly authorize the operation of UAS under 55 pounds if the operations take place under a set of parameters to maintain safety, including operating at speeds below 100 mph and below 500 feet in altitude.

Additionally, as part of our efforts to streamline the integration of this technology, the FAA has further expedited safe UAS integration and facilitated commercial use by issuing a blanket Certificate of Waiver or Authorization (COA) for flights at or below 200 feet when it issues a section 333 exemption. The blanket COA can be used for UAS operations that involve aircraft that weigh less than 55 pounds, operate during daytime Visual Flight Rules (VFR) conditions, operate within visual line of sight (VLOS) of the pilots, and stay at the prescribed distances away from airports or heliports.

From the outset, we have worked closely and successfully with government partners and industry stakeholders to achieve milestones put forward by the 2012 Act. In coordination with other governmental agencies and industry, we developed two long-term planning documents, the Comprehensive Plan and a five-year Roadmap. We have worked with members of the UAS Executive Committee (ExCom), comprised of representatives of various government agencies and departments with responsibilities in this area, to leverage our collective assets and conduct research and development on UAS integration while ensuring the continued safety of the NAS. The FAA collaborated with the National Aeronautics and Space Administration (NASA) on studies advancing air traffic control interoperability with future use by UAS of detect-and-avoid (DAA) systems in controlled airspace. We continue to collaborate with the industry on flight tests to validate RTCA[1] standards for DAA systems as well as command and control radios. RTCA began work on the standards at the request of the FAA in 2013 and they are scheduled for completion in 2016. These standards will help resolve two of the difficult challenges facing the industry for integration of UAS into the NAS. NASA, the FAA, and industry partners have successfully demonstrated a proof-of-concept airborne DAA system and prototype radios for use as command and control systems for UAS.

We are already looking beyond the small UAS rulemaking at what comes next in terms of the types of operations expected, and what technologies we may need to certify to ensure safety. The FAA has consulted with the UAS ARC to determine the next areas of focus so we can enable those UAS operations with the highest net societal benefits. These recommendations are

[1] RTCA, Inc. is not-for-profit organization that serves as a federal advisory committee to the FAA. *See* http://www.RTCA.org.

being assessed and will result in additional focus areas that will become the centerpiece for FAA's strategic plans for UAS integration.

As the aerospace industry and aviation system grow more complex, we must ensure that our resources are directed to those areas which pose the greatest risk to safe aviation operations. We will need to expand collaborative, data-driven processes with the UAS industry to improve safety and streamline process in areas such as certification. We must meet challenges and take advantage of opportunities.

The safe integration of UAS into the NAS will be facilitated by new technologies being deployed as part of the Next Generation Air Transportation System (NextGen). NAS Voice System (NVS), Data Communications (Data Comm), and System Wide Information Management (SWIM) will provide more information, flexibility, situational awareness, and a greater ability to communicate with NAS users.

To enhance safe application of new and emerging technologies, earlier this year, FAA established the Pathfinder Program, which was referenced above. In the Pathfinder Program we work with three companies to obtain important information on the next steps beyond operational parameters included in the small UAS notice of proposed rulemaking. For visual line of sight operations, FAA is working with CNN on how UAS might be used for news gathering in populated areas. We are also working with the UAS manufacturer Precision Hawk to explore beyond visual line of sight operations in rural areas. Precision Hawk will be working to explore how flying beyond the pilot's direct vision might be used to allow for greater UAS use for crop monitoring in precision agricultural operations. BNSF Railway will explore command and

control challenges of using UAS to inspect rail system infrastructure. Developing the safe use of this important technology can only benefit how UAS can be used in the future.

Aviation technology is constantly evolving. This is certainly not the first time we, as an agency, have been required to integrate new aviation technology into the NAS. Different aircraft technologies, including jet engines, were required to be accepted operationally and we handled them as they developed. Today, in addition to UAS, we are working to integrate commercial space technology into the NAS. Clearly, there will be other technologies that we will be required to integrate moving forward.

I am proud of the team we have brought together and of the approach we are taking to ensure that our airspace continues to be the safest in the world, even as we work to accommodate new technologies that have the potential for changing the way we live our lives. This is an exciting time to be part of the FAA. I am happy to have had the opportunity to speak with you this morning and I will be glad to answer any questions you have.

Michael G. Whitaker, Deputy Administrator, Federal Aviation Administration
Responses to Questions for the Record (QFRs)
"Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems"
COMMITTEE ON TRANSPORTATION AND INFRASTRUCUTRE
Wednesday, October 7, 2015, 10:00 a.m.
2167 Rayburn House Office Building
Washington, D.C.

Submitted on behalf of Congressman Frank A. LoBiondo

QUESTION 1: Administrator Huerta, given that risk is impossible to eliminate entirely, what do you consider an acceptable level of risk from unmanned aircraft?

Answer 1: The FAA's incremental approach to UAS integration recognizes that different types of operations have different levels of risk. For example, the agency's proposed small UAS rule mitigates risk through operational limitations – such as keeping the aircraft within line of sight and below a certain altitude. It also would ensure that operators have relevant information by creating a UAS-specific pilot certificate. Operations such as those with larger aircraft or that go beyond line of sight will require different mitigations. The FAA is committed to working with industry and government partners to help assess appropriate risk mitigations as we move forward with integration.

Submitted on behalf of Congressman Sam Graves

QUESTION 1: Over the last year, states and municipalities have attempted to regulate UAS use of the National Airspace System in the name of safety and privacy. However, the Federal Government has exclusive sovereignty of airspace of the United States. Has the FAA provided guidance to states that the federal government has preemption over this issue?

Answer 1: The FAA regularly discusses general matters of preemption with interested states and local governments. Whether state or local requirements placed on the operation of unmanned aircraft are preempted by federal law depends on the precise nature of the requirements. The Department of Transportation would evaluate these laws on a case by case basis to ensure they do not conflict with FAA's authority to ensure the safe and efficient use of U.S. airspace.

QUESTION 2: Enforcement of current laws and regulations are an essential component of deterrence.

a. What specific statutes are currently on the books that would allow for the FAA to pursue legal action against any individual that breaks those laws or regulations?
b. Does the FAA have enough resources to dedicate to enforcement activity?
c. How is the FAA working with other law enforcement entities, either federal, state or local, to better crack down on these types of illegal operations?

Answer 2: The FAA has available its full range of enforcement actions described in the agency's compliance philosophy and the Compliance and Enforcement Order. However, the key challenge in taking enforcement action against UAS operators who conduct unsafe or unauthorized operations is identifying the operator.

The FAA is conducting extensive outreach with local, state and federal law enforcement to develop a relationship wherein law enforcement has the tools to respond to a potential unsafe or unauthorized UAS event and to inform the FAA of such events.

The FAA published guidance for law enforcement as a part of this outreach effort. The guidance covers the laws applicable to UAS operations, the information needed by the FAA to investigate a UAS operation, and contact numbers for the FAA.

When an operator is identified and the operation warrants legal enforcement action, the FAA is taking such action, including assessing civil penalties and in cases of operators who hold FAA issued certificates, proceeding with action against that certificate such as suspension or revocation.

In cases that rise to the level of criminal conduct, the FAA is working with local, state, and federal law enforcement to assist in proceeding with those cases.

QUESTION 3: Once finalized, the small UAS rule will allow for only a small sliver of safe commercial operations.

a. How is the FAA planning to address the next phases of commercial UAS operations, to include beyond line-of-sight operations, platforms over 55 pounds, and operations above 500 feet?
b. Since the FAA's UAS roadmap is outdated and the FAA disregarded the congressional mandate to update it annually, are there any plans to update the UAS roadmap?

Answer 3: In May 2015, the FAA announced a partnership with industry to explore the next steps in unmanned aircraft operations beyond the type of operations the agency proposed in the draft small unmanned aircraft systems (UAS) rule published in February 2015.

The FAA is working with industry partners on three focus areas, including:

- Visual line-of-sight operations in urban areas
  - CNN will look at how UAS might be safely used for newsgathering in populated areas.
- Extended visual line-of-sight operations in rural areas
  - This concept involves UAS flights outside the pilot's direct vision. UAS manufacturer PrecisionHawk will explore how this might allow greater UAS use for crop monitoring in precision agriculture operations.
- Beyond visual line-of-sight in rural/isolated areas
  - BNSF Railroad will explore command-and-control challenges of using UAS to inspect rail system infrastructure.

The next edition of the UAS Integration Roadmap is in executive coordination.

QUESTION 4: If a recreational UAS happens to collide with a commercial airliner, the resulting damage would be catastrophic. Has anyone given thought as to how the liability resulting from such an incident would be sorted out?

Answer 4: The FAA is conducting an ongoing and robust public education program on how to safely operate UAS, including the need to be aware of airspace safety requirements and to yield the right-of-way to manned aircraft to help prevent this type of accident. The DOT and FAA recently announced a program to require registration of UAS to help identify operators in part to encourage people to follow the rules. However, we would expect that determination of liability arising from such an incident would be handled similarly to other manned aviation incidents.

QUESTION 5: In the auto sector, we hedge our financial exposure to accidents with insurance products. With the explosion in the number of individuals and businesses using UAS, what do you see as the eventual role of liability insurance in the space?

Answer 5: The FAA is aware that the insurance industry is involved in the UAS arena. As the use of UAS grows we would expect insurance activity to grow as well.

STATEMENT OF

JAMES HUBBARD, DEPUTY CHIEF

FOREST SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

BEFORE THE

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

AVIATION SUBCOMMITTEE

UNITED STATES HOUSE OF REPRESENTATIVES

OCTOBER 7, 2015

CONCERNING

Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to present the views of the Forest Service regarding the safety of Unmanned Aircraft Systems. Increasingly severe fire seasons are one of the greatest challenges facing the Nation's forests and 2015 has been no exception. The Forest Service and the Department of Interior (DOI), in full coordination with our state and local fire response partners, are responsible for responding to unplanned wildland fire incidents which threaten lives, property and resources. The agency mobilizes ground crews, fire engines, helicopters, airtankers and other assets in our suppression efforts. At the same time we are investigating the potential of using Unmanned Aircraft Systems (UAS), we have also experienced unwanted incursions from recreational drones in our suppression efforts.

WILDLAND FIRE SUPPRESSION

The United States has developed a complex and sophisticated wildland fire response framework that is composed of local, state, tribal and federal entities. Federal and state land and fire managers, Tribes, non-governmental organizations, and other stakeholders work as partners to safely and effectively extinguish fire when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire. Each entity has specific responsibilities for responding to wildfires occurring within their jurisdiction (initial response). Federal, state and local entities also coordinate and share resources and responsibilities as fires become larger and exceed the local response capacity. Fortunately, local response capacity is generally all that is needed for controlling or extinguishing most wildfires, though escalating risks including more people moving into (and next to) wildland areas may impact response effectiveness in the future.

During this fire season, we spent 24 days at National Preparedness Level 5 -- the highest level -- meaning all available ground and air assets are committed to priority work. Severe drought across the west has increased fire severity in several states. Washington State, among others, recorded a record season of severe wildfires. Drought-ridden California also experienced tremendous fire activity. The Forest Service and DOI, in coordination with our state and local fire response partners, mobilized over 27,000 firefighters along with numerous airtankers, helicopters, fire engines and other assets through our integrated, interagency suppression efforts.

Every state, Puerto Rico and Pacific Island, along with the military and international support, has provided people and equipment this season to help manage over 50,000 wildfires.

This season, over 9 million acres burned across the United States and destroyed over 2,500 single residences. The greatest losses, however, involved the fatalities of 13 wildland firefighters who made the ultimate sacrifice to protect the lives of others. Our thoughts and prayers will forever be with their family and friends.

AIRSPACE ABOVE WILDLAND FIRES

Aviation operations are one of the highest risk suppression activities we perform. Large airtankers and helicopters are often mobilized during initial response and extended attack suppression efforts. Often, we request and receive a temporary flight restriction and a Notice to Airmen to maximize safe airspace over wildfires. The airspace above large fires is very complex. Firefighting agencies have established a communication protocol known as the Fire Traffic Area (FTA) to reduce risk in the airspace over a wildfire. The FTA establishes a protocol for communication and operations by firefighting aircraft. In general, fire aircraft must make radio contact with the command and control "Air Attack" when they are 12 nautical miles from the fire. If contact is not made, the fire aircraft will remain outside the area orbiting a minimum of seven miles away. Once cleared into the FTA, there is a structure based on altitude for the various missions. Air Attack remains at higher elevations above the tactical aircraft to retain the best visual perspective. Airtankers waiting their turn stay higher in altitude than those maneuvering for a retardant drop. Helicopters operate at the lower altitudes as their mission often involve transport of firefighters, cargo or water. The complexity of the airspace above a wildfire can rapidly change as fire activity increases, resources arrive on scene and smoke reduces visibility. Safety depends on understanding what other aircraft are in the airspace and where those aircraft are operating.

USE OF UNMANNED AIRCRAFT SYSTEMS

UAS are among the technologies that hold significant potential to aid in fire detection and increase firefighter safety efforts. We aim to be a leader in embracing the new technology and enhancing our capacity to accomplish our mission to "sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." The Forest Service established a UAS Executive Steering Committee to coordinate efforts with our state and federal partners. The Executive Steering Committee is charged with developing policy regarding the operation and use of UAS, including natural resource research along with recreational use on National Forest System (NFS) lands. Through Executive Steering Committee guidance, policy will be evaluated and updated with UAS technology in mind to ensure safe and efficient integration of UAS in government mission and public safety for forest visitors.

As a part of our efforts to explore new technologies to enhance firefighter safety and effectiveness, we partnered with DOI's Office of Aviation Services to develop a 2015 Unmanned Aircraft Technology Demonstration Strategy. The Strategy outlines a five-phase process enabling us to test UAS capabilities to support fire suppression efforts by completing scenario-based missions. The Forest Service and DOI will develop summary of the activities during the

2015 field season, along with lessons learned, and will then make recommendations on further integration of UAS on a national level.

Although the focus of today's hearing is UAS and wildfire, the Forest Service is aware of the potential of UAS to augment the agency's capacity to gather information to support several resource management programs. Examples include mapping, monitoring the condition of natural resources, assessing the effectiveness of natural resource management projects, engineering inspections, and public use inventories.

We have identified five main ways the wildland community can benefit from UAS in fire management including:

1. ***Increasing awareness of ground resources regarding real time fire characteristics, such as location, behavior and spread.*** A small UAS above the tree canopy can help ground assets learn more about fire activity in their vicinity. In some situations, heat signatures or infrared sensors could help in smoky or other low visibility situations.
2. ***Enhancing safety through scouting fire line and identifying escape routes and safety zones.*** Significant potential exists to enhance firefighter safety by aerially assessing the terrain, condition of fuels, fire behavior, and potential escape routes without putting a human in dangerous situations.
3. ***Tracking and monitoring ground resources in real time.*** UAS technology can help provide accurate locations of personnel and equipment and direct them to strategic locations or advise them out of dangerous situations.
4. ***Enhancing communication links.*** Use of UAS can help link radio communications when terrain hinders line of sight transmissions or over a larger area for longer term incidents.
5. ***Supporting aerial supervision and mapping in low visibility situations.*** UAS tools can observe ground crews and providing mapping capabilities in smoky or other low visibility situations.

We continue to investigate the future possibilities for potentially deploying UAS for direct attack and supply support.

DRONE INCURSIONS

In 2014, we experienced four incidents during the fire season where a non-participating UAS was flown over or near a wildfire, neither of which affected firefighting aircraft. This season, there have been 21 documented instances of UAS incursions near and over wildfires with ten being over NFS lands. Twelve of the incidents required firefighting aircraft to stop operations and shut down, relocate to another area or be grounded at base. In two of the events, firefighting pilots reported taking aggressive maneuvering action to avoid a collision. Approximately five hours of operational time was lost while ensuring the risk of mid-air collisions had been mitigated. These incursions by untrained operators inhibited the ability to deliver retardant and water to slow the fire's advance; prevented transportation of firefighters to vital locations for fire suppression and containment efforts; and stopped cargo delivery.

While it may be hard to quantify how shutting down air operations affects a wildfire's growth, we do know a rapid response including aviation assets, is successful in suppressing fires while

they are small and controllable. In a well-publicized UAS wildfire incursion in Southern California, five non-participating UAS were flown during critical fire suppression activities on the North Fire. At the time the first non-participating UAS was spotted, the fire was only 4-5 acres, but was spreading rapidly. The two airtankers over the fire were directed by a smaller fixed-wing aircraft known as the lead plane. Two helicopters were dropping water in an effort to slow the fire's growth. Once a UAS was observed in the airspace over the fire, all six firefighting aircraft broke off suppression activity and relocated away from the fire. The command and control aircraft, known as air attack, then proceeded to assess the airspace. Multiple UAS were identified over the fire. After an approximate 20-25 minute delay, the firefighting aircraft re-engaged with suppression activities. By then, the fire had crossed over Interstate 15, with life and property at risk. The North Fire ultimately consumed 4,250 acres, burned or destroyed 74 vehicles, and destroyed 23 structures before it was stopped. Fortunately, there were no injuries reported.

COORDINATION WITH OTHER FEDERAL, STATE AND LOCAL AGENCIES

The Forest Service is coordinating with other federal, state and local agencies on several efforts including utilizing UAS in the National Airspace System, public education campaigns and UAS monitoring technology.

Utilizing UAS in the National Airspace System

The Federal Aviation Administration (FAA) and DOI have a Memorandum of Agreement (MOA) to allow DOI to fly UAS in the National Airspace System under a notification system for over a year. The Forest Service is currently working toward an MOA with FAA as well. The MOAs streamline airspace approval and reduce processing time to obtain a Certificate of Authorization. The Forest Service is grateful that the FAA has been active in helping to find solutions to the UAS wildfire incursions and in facilitating UAS integration into Forest Service operations.

Public education campaign

In 2014, shortly after the first UAS was seen near a wildfire, the Forest Service, in partnership with other federal, state, and local agencies issued a national news release urging members of the public not to fly UAS near wildfires. Shortly thereafter, the Forest Service developed a poster for use in public education and outreach with the slogan "If you fly, we can't". The campaign has evolved to include a series of tools to help promote aviation safety including several public service announcements and short videos, news releases, and Facebook and Twitter posts.

As UAS incursions began to increase, a concerted public education effort began through news releases, social media posts, local news conferences, preliminary discussions with the Ad Council, direct outreach to the UAS industry and hobbyist communities through the FAA "Know before you fly campaign," the Association for Unmanned Vehicle Systems International, and the Academy of Model Aeronautics. We continue to coordinate with the FAA, and DOI to identify and coordinate public education efforts and determine success can be accomplished.

UAS Monitoring Technology

The United States Department of Agriculture (USDA) Office of Homeland Security and Emergency Coordination (OHSEC) facilitated UAS technology coordination between the Forest

Service and the Department of Homeland Security (DHS). DHS is adding wildfires to their modeling process to help identify technology that might be of benefit to fire managers in addressing UAS incursions. The Forest Service is providing DHS with information about fire operations, fire environment and non-participating UAS airspace issues and will provide opportunities to assess technologies in live fire environments as the project progresses.

CONCLUSION

The use of UAS holds significant potential to increase firefighter safety, and to assist in suppression efforts. At the same time, we remain very concerned about the dangers to firefighters and the public associated with non-participating UAS incursions in airspace above a wildland fire. We look forward to working with the subcommittee to identify specific protections that would allow wildland firefighters to take action on individuals who operate UAS over emergency situations.

STATEMENT OF

CAPTAIN TIM CANOLL, PRESIDENT

AIR LINE PILOTS ASSOCIATION, INTERNATIONAL

BEFORE THE

SUBCOMMITTEE ON AVIATION

COMMITTEE ON TRANSPORTATION & INFRASTRUCTURE

U.S. HOUSE OF REPRESENTATIVES

WASHINGTON, DC

OCTOBER 7, 2015

"ENSURING AVIATION SAFETY IN THE ERA OF UNMANNED AIRCRAFT SYSTEMS"

Air Line Pilots Association, International
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STATEMENT OF
CAPTAIN TIM CANOLL, PRESIDENT
AIR LINE PILOTS ASSOCIATION, INTERNATIONAL
"ENSURING AVIATION SAFETY
IN THE ERA OF UNMANNED AIRCRAFT SYSTEMS"
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The Air Line Pilots Association, International (ALPA) represents more than 52,000 pilots who fly for 31 airlines in the United States and Canada. Thank you for the opportunity to provide our perspective on the critical importance of safely integrating unmanned aircraft systems (UAS) into the U.S. national airspace system (NAS), the most dynamic and diverse such system in the world. The NAS must be protected and maintained to deliver the safest and most efficient air transportation services in the world. Although our focus today is the NAS, we must point out that the safety issues highlighted are independent of any national airspace boundary and are faced by ALPA's pilots as we operate around the globe.

UAS Risk Must Be Effectively Managed to Realize Benefits

ALPA recognizes that UAS represent a significant potential for economic and societal benefit. They are uniquely suited for performing many types of dangerous flying that can keep pilots out of harm's way. ALPA supports robust development of this technology with one single overriding condition: integration of UAS into the NAS must be done safely, deliberately, thoughtfully, with full understanding of the possible risks also being introduced, and most importantly—with simultaneous development of effective mitigations for those risks. We have to do this right, or the enviable safety record we have achieved in airline operations will be at risk, and with it, the promise of employing unmanned systems for the benefit of the population.

As we have for many years, ALPA continues to be an active partner with both government and industry in developing standards that will lead to safe operation of unmanned systems in the NAS. Concurrently, we recognize that these standards are far from complete. Defining a safety framework for any new technology is necessarily a painstaking process, and ALPA, along with hundreds of extremely talented representatives from across aviation, is diligently pursuing that goal.

UAS Sales Growth

Among the most dramatic and challenging revolutions in aviation technology and operational capability to be introduced into the NAS is the UAS. There are many different types of UAS, and there seems to be an ever-expanding list of potential applications.

There are many published data sources that support this key fact: *there is tremendous growth in the sale and use of small UAS for both hobby and commercial use.* Research suggests that there are likely more than 700,000 UAS already in the hands of the public, many of whom undoubtedly have very little appreciation for, or understanding of, how to safely operate UAS in airspace that is used by commercial aviation.

Additionally, the FAA has stated that upwards of 1 *million* UAS could be sold this coming holiday season. Although the FAA has made strides toward developing a regulatory

framework for the operation of some of these aircraft, much work remains. In the meantime, the FAA is publishing data that increasingly point to a UAS threat to safe operation of airline aircraft. Immediate action is required to address the documented hazards.

FAA Addresses Commercial Small UAS Operations

The FAA has taken initial steps to allow small UAS (sUAS, under 55 pounds) to begin operating in the airspace system with multiple restrictions intended to mitigate risk. The FAA has established an interim process of approval of commercial operations on a case-by-case basis. This is often referred to as the "Section 333 process" because the FAA's use of this strategy is based on that section of the most recent FAA authorization.

In addition to the interim approval process, the FAA published a notice of proposed rulemaking (NPRM) on Feb. 23, 2015, that addressed the commercial operations of sUAS. The NPRM, which was significantly based on FAA's 2009 recommendations of the Small UAS Aviation Rulemaking Committee, established a proposed framework for commercial operators to operate their sUAS. The NPRM formally established the definition of an sUAS, established pilot qualifications, and created operational limitations.

By the end of the notice's 60-day comment period, the FAA had received more than 4,000 comments. While ALPA supports the FAA's efforts to properly establish regulations for commercial sUAS operations, ALPA and other organizations encouraged the FAA to make some substantial changes.

The FAA is now reconciling ALPA's comments along with all of the others and will ultimately issue a final rule. Between the Section 333 process and the eventual sUAS rule, commercial operators are well on their way to having a defined path for approved NAS operations and a path for expansion of operations while insuring safety.

The FAA Needs to Address All UAS to Ensure Safety Immediately

The standards for some of the key capabilities of UAS, and the recommendations for the wide variety of rules that must be changed or developed to accommodate large UAS, are still years away. As a result, for the foreseeable future, without additional FAA action there will be no rules for the following UAS operations:

- Non-commercial operations by companies (e.g., pipeline or power line patrol by the pipeline/power line company employees)
- Recreational/hobbyist small and large UAS
- Commercial large UAS

ALPA recognizes that the commercial operations of large UAS are not developing as quickly as sUAS used for commercial, recreational and corporate operations. The FAA presently has rulemaking underway that addresses only one of these four types of UAS operations. The tremendous growth of sUAS in just the last 24 months when measured against the limited rules that the FAA has under way is inconsistent with the needs of the country for safe integration of UAS.

Recent FAA Incident Report Data Is Demonstrative of ALPA Safety Concerns

This August, the FAA published a list of pilot reports on UAS encounters. ALPA reviewed the 764 events, which cover only a 10-month period from November 2014 through August of 2015. Both the volume of events and many of the event descriptions are sobering reminders

to the industry that the risk of a collision between a UAS and an airline aircraft has increased significantly. Consider these sample summaries (ALPA paraphrase):

New Jersey:

- 07/16/2015 Summary: Regional turboprop aircraft on a one-mile final approach to Runway 11 reported a remote controlled aircraft 50 feet below at Weequahic Park.

- 08/09/2015 Summary: Several aircraft on final to Newark Liberty International Airport reporting unidentified drone operating directly on final approach to Runway 4 right. The drone was reported to be at altitudes between 2,000 and 3,000 feet, between 8 miles and 13 miles out on the final approach. Three aircraft reported the drone in sight.

Oregon

- 05/17/2015 Summary: Regional jet at 1,000 feet on a two-mile final for Runway 34 left. Pilot reported seeing a drone at 600 to 700 feet off his left wing. It was approximately 400 to 500 feet from the aircraft. The drone was described as a yellow hobby-style helicopter with four rotors the size of a large bird.
- 07/21/2015 Summary: Turboprop commercial freight aircraft reported a "drone" at 1,100 feet on base for Runway 28 left over "Rocky Butte" (a hill approximately 2.5 miles southeast of Portland International Airport)

Washington

- 07/15/2015 Summary: Regional jet reported a drone at 2,400 feet on a 5-mile final to Runway 16 right. The pilot reported that the drone was above him on final and appeared to be a black quadcopter.

- 04/27/2015 Summary: Jet airliner was descending through 3,500 feet on the downwind near Vashon Island (near Seattle) and sighted a deep blue metallic drone. The drone passed about 100 to200 feet under his left wing and appeared to be traveling northwest.

ALPA also studied the work of others who have reviewed the FAA event data. The Center for the Study of the Drone, which is operated by Bard College in New York State, has indicated that of the total number of reported events in the database, 302 of the 764 reports were determined to be near misses. In other words, its analysis revealed that 39.5% of the FAA's events would potentially have met the FAA's near mid air collision (NMAC) criteria. In comparison, ALPA research of FAA data regarding manned-on-manned aircraft NMAC finds that a total of 41 NMAC reports were logged in the same period. It should be noted that FAA NMAC reports are voluntarily submitted and therefore likely not a comprehensive set of manned-on-manned NMAC reports.

It is clear that hundreds of NMAC of UAS over such a short time frame far exceeds an acceptable level of risk to manned aircraft in the NAS. Undoubtedly there will be many perspectives and opinions on what constitutes an acceptable level of risk. If the FAA UAS event data tallied 100 instead of 764, ALPA would still insist that there are too many unexpected encounters.

Instead of discussing subjective opinions on the risk that UAS pose on manned aircraft, ALPA suggests that the FAA should invite ALPA and others in the industry to work collaboratively to reach an agreement on the level of risk that is deemed acceptable, and then work to implement solutions to achieve the targeted risk levels. The rate of UAS encounters needs to be reversed, and ALPA is ready and willing to immediately contribute in a meaningful way to reverse the growing trend of UAS encounters.

Non-Commercial and Recreational UAS Operations Appear to Be a Major Source of Reported UAS Events

Although the FAA has made progress in attempting to educate non-commercial and/or hobby users as to the safe operation of their aircraft through its "Know Before You Fly" campaign, no regulations exist that govern the operation of the aircraft or the training and experience of the pilots. ALPA believes that the vast majority of the many "close encounters" with unmanned aircraft reported by airline flight crews are the result of users who either do not understand the potential severity of operating near airports and aircraft, or are completely unaware that they are doing so. The massive growth of this segment clearly has outpaced the FAA's ability to effect safety standards that apply to it, yet the FAA remains responsible for the safety of all operations in the airspace. This is a significant gap that must be addressed. The FAA must have the ability to ensure the safety of the NAS regardless of the types of unmanned operations being conducted, and it must have the resources necessary to act on that mandate. As we have said before, we simply cannot afford to quantify this hazard by analyzing the damage after an unmanned system collides with an airliner.

UAS Frangibility Is Questionable and Untested

ALPA is concerned about the impact of sUAS on an airline aircraft if there were a collision. There are numerous videos of UAS crashes online; in many cases the crashes occur without major damage to the camera and the visible parts of the sUAS. It appears that the sUAS are generally designed to be relatively rugged, as one would expect for a commercially viable product. This ruggedness however, needs to be evaluated in the context of the potential damage that an sUAS would impose on an airline aircraft should the two collide. We frequently hear the comment that most sUAS are small, lightweight plastic aircraft. While this is the case for the sUAS airframe itself, the multiple propulsion units, batteries, and on-board cameras are hard metal with a significant density that a bird, for instance, does not have.

Airplane engines, windscreens, and other components may suffer the impact of such material without resulting in loss of the aircraft, but the damage would be nevertheless significant. Jet engines, for example, are notoriously susceptible to foreign object damage (FOD) typically caused by small, hard objects found all over airports – nuts, bolts, rocks, tools, etc. Damage of this type, while rarely noted in conjunction with an accident, costs the industry billions of dollars every year.

Similarly, we have seen just in the past few months the extensive damage done to an aircraft in flight by hail, shattering both pilots' windscreens and severely damaging every part of the airplane that was hit. Here again, catastrophe was averted by the robustness of the airplane design and the skill of the flight crew, but the seriousness of striking hard objects in flight was clearly illustrated. Based on our experience with FOD, hail, and other objects striking transport aircraft, ALPA recommends design evaluations, modeling, and testing the collision impact of some of the more popular sUAS.

UAS Conspicuity – Data Suggests That They Are Difficult to See Until Close

ALPA is frequently asked to explain how visible an sUAS is to a flight crew of an airline aircraft. There are medical studies about the limits of human visual acuity and some limited study data on distances at which a pilot perceives other aircraft. However, because UAS can be of essentially an infinite variety of sizes, shapes, and colors, studies regarding traditional aircraft do not provide a good guide. Factors such as size, shape, contrast with background, and movement relative to the observer are all factors that complicate a pilot's ability to see a UAS until it is extremely close and often too late to safely take evasive action. It is important to note that from a safety perspective, a pilot simply seeing an object in the airspace is only part of the process. The object must be seen with enough clarity and at such a distance that a pilot has the ability to identify the object and determine if evasive maneuvering is necessary to avoid a collision. To our knowledge, no specific quantifiable data on observing UAS from an aircraft moving nearly 200 mph in time to avoid collision exist.

ALPA Members Encouraged to Report UAS Sightings

In order to continue to track the rate of UAS encounters, ALPA has taken the initiative to encourage pilots who encounter an sUAS to follow their company guidance and, where applicable, file a report of the encounter with the FAA. A dedicated page on ALPA's website (www.alpa.org), available to anyone, not just members, helps pilots understand whether the encounter was likely reportable as a near mid air collision and provides web links and information needed to submit the necessary information.

True UAS Integration: Much to Do to Achieve One Level of Safety

While it is easy to focus on very near-term, dynamic growth and the recent news created by the FAA, it is important to understand the broader challenges that still exist for nationwide integration of UAS into the NAS. By way of review, UAS are grouped into two separate categories, generally based on weight. Aircraft that weigh 55 lbs. or less are defined as "small" UAS (sUAS) and unmanned aircraft that weigh more than 55 lbs. are considered "large."

Small UAS are typically intended for use at low altitudes, in clear weather, and within sight of the pilot. However, the aircraft themselves are capable of achieving altitudes, speeds, and ranges that extend far beyond the intended limits of their use. In addition, applications are being developed to employ these aircraft in an autonomous role, meaning they could operate along a predetermined flight path without being under the direct control of a pilot. While the commercial applications for sUAS are expanding rapidly, so too is the appeal to hobby users. In both cases, the potential exists for these aircraft to stray into airspace occupied by other NAS users, most notably by airline aircraft near airports.

Large UAS aircraft can be as large as a small airliner and can operate essentially anywhere conventional aircraft operate, and in many cases have performance capabilities exceeding those of conventional aircraft. While differences in size, performance, and operational capabilities can vary greatly, there also exists a wide range of technology on the ground that forms the entire system that must be considered in evaluating the safety of integrating these aircraft into the NAS, not just the aircraft itself.

Until comprehensive solutions are developed and promulgated by the FAA, our overarching position is that no unmanned aircraft, public or civil, should be allowed unrestricted access to conduct flight operations into the NAS unless it meets all of the high standards currently

required for every other airspace user. This means UAS must be designed to interoperate, with similar performance and functional requirements at the heart of their system, and have architectures embodying state-of-the-art safety technologies and system redundancies as required by currently certified commercial and general aviation airspace users. Of particular importance and concern is the ability of commercial aircraft operating in the NAS to safely perform see-and-avoid and collision avoidance maneuvers against UAS that may be operating in the same area.

ALPA's position is that the foundation of operating an aircraft, and the system functions therein, in a safe and responsible manner must be maintained at the same level of safety regardless of the location of the pilot or levels of automation. At the center of current commercial aviation flight operations is a well-trained, well-qualified professional pilot. A well-qualified pilot remains the single most important safety component of any commercial aircraft. A UAS should be able to operate as a part of the NAS, with similar certification standards and regulations to meet the target level of safety that is performed reliably and repeatedly by well-trained airline pilots and their aircraft in the NAS today. Accordingly, UAS operators performing commercial operations should be required to meet all the certification and equivalent safety requirements of a commercial operator. And the pilots flying the aircraft must meet equivalent training, qualification, and licensing requirements of pilots of manned aircraft in the same civil regulated airspace.

UAS Design Standard Challenges

Unmanned operations are envisioned to afford possibilities and convenience that offer the attraction of a flying technology beyond the conventions and constraints of modern aviation. The reality is quite different; new UAS technology currently lack – but must have – the standardization of safely integrated and interoperable certified systems, which the FAA requires of commercial operators in the NAS today. Without mature safety standards and without technologies that have certification standards and regulations, safety in the NAS may be significantly and negatively impacted, introducing more vulnerability and risk to commercial airline operations and to an overburdened Air Traffic Control system.

Currently, the UAS technologies, safety, and certifications for an end-to-end solution for NAS integration are immature. Patience and, most importantly, collaboration are needed to diligently examine all of the barriers and successfully develop comprehensive and fully mature solutions prior to widespread operational implementation into the NAS. We simply cannot afford to miss critical steps in technological design standards and safety analyses in an attempt to hastily satisfy a market demand, because the impacts to the safety of the NAS could be profound, far outweighing any benefits.

The introduction of multiple variations of UAS without first completing comprehensive risk analysis, rigorous testing, and robust aircraft and pilot certifications would set back the progress accomplished in aviation safety while simultaneously losing the public's trust of safe air travel. We believe that all aviation stakeholders should examine UAS integration to determine how these platforms may impact their operations.

Technological Challenges Impacting Operations in the NAS

A June 20, 2014, newspaper article[1] reported that 47 UAS accidents involving U.S. military and federal agencies' aircraft have occurred since 2001 – a safety record that no commercial business or airline could survive. These federal institutions have the authority to self-certify the airworthiness of their own UAS, which can involve modifying compliance with FAA certification standards to accommodate these agencies' unique mission requirements. This latitude and difference in priorities relative to commercial aviation is likely a contributing factor to the number of UAS accidents.

As such, it is easily understood that without the FAA's and other safety organizations' experience and collective guidance in aviation safety, lesser airworthiness standards and certification procedures will produce greater UAS accident rates. Moreover, these accident rates expose the importance of developing civil standards tailored explicitly to UAS technologies, airworthiness, and related certifications through established civil procedures.

Unlike their manned counterparts, a primary system on a UAS is the communication and control system (C^2). This system is what allows the pilot to remotely control the aircraft. The system transmits and receives command inputs (e.g., flight controls, navigation, aircraft status, and ATC communications) from the ground station via radio frequency to the unmanned aircraft (UA). The criticality of the C^2 system becomes self-evident, as it is the most vital single-system link depended upon for the UAS to successfully and safely operate. Link failure – which is exactly analogous to the pilot of an aircraft suddenly disappearing from the cockpit – may cause a multitude of unintentional, cascading events. The sole dependence on this vital system is a necessary aspect of UAS operations, but its failure is one of the primary causal factors as to why UAS have had many accidents.

The primary C^2 contributing failures are associated with latency issues – that is, the time between transmission and reception of a command to successfully operate the UAS. Unlike the human on-board pilot, whose control input is instantaneous, latency times can be from 3 seconds to as much as 30 seconds, perhaps more. When flying in the NAS, where immediate communication and required actions are expected to provide separation between aircraft, latency could cause more significant problems for ATC and manned aircraft in that airspace.

The varying degrees of UAS C^2 vulnerabilities and failures creates complex safety issues for UAS integration. The C^2 data, voice, and video requirements placed on operating UAS using radio waves or satellite create limitations that currently prevent UAS from performing to the safety level of manned commercial aircraft operations. If a UAS cannot maintain a C^2 link, the normal expectation of a UAS to perform the critical functions of ensuring separation from terrain, obstacles, and other aircraft, as well as collision avoidance responsibilities, will unduly place safety burdens on other NAS users.

Manned aircraft flown by pilots in the NAS today use instrument flight rules (IFR) to take advantage of the benefits of FAA's ATC separation services. However, a pilot's responsibility to see and avoid to remain well clear of other aircraft is a constant responsibility in the pilot's line of work, regardless of who or what else is monitoring the flight. Simply stated, pilots visually scan the airspace, especially when traffic is being reported to them by ATC, to identify the aircraft in question when a traffic alert is initiated or simply when a flight crew is flying into an airport that may not have a control tower to avoid all potential conflicts. The UAS needs to be equipped with the technological ability to maintain well clear of and

[1] "When Drones Fall from the Sky," *Washington Post*, June 20, 2014.

avoid collisions with other operators if it is to truly replicate the actions expected of every aircraft in the NAS.

A robust and safe UAS design should never result in the transference of safety responsibility – such as that for maintaining separation – to other operators and users. Accordingly, one of the most important capabilities yet to be developed for UAS operations is the detect and avoid (DAA) technology that is fully capable of performing two primary functions: staying well clear of other aircraft and, if that fails, retaining the ability to avoid an imminent collision using an active collision avoidance technology. While those capabilities in manned aircraft are accomplished by a combination of pilot skill and electronic means, UAS must solely rely on electronic means. The responsibility to avoid coming hazardously close to other aircraft is a shared responsibility.

In addition to the UAS ability to detect and avoid aircraft, other aircraft in the NAS must likewise be able to "see" any UAS that could pose a collision threat. Realistically, given sizes too small to be seen by the human eye until the aircraft is dangerously close, the ability to be seen must be done by electronic means.

A promising system to enable that capability is aAircraft cCollision aAvoidance sSystem for NextGen, or ACAS X. Currently in the research and development phase, only limited funding exists to develop and implement this groundbreaking technology. Additional funding for ACAS X (for manned aircraft) and ACAS Xu (for UAS) would accelerate this new capability. This new technology will likely play a critical role in the safe integration of UAS platforms into the NAS, as well as ensure harmonization of UAS with NextGen requirements.

Geographically Limiting Technology for UAS Operations

Technology exists to limit the geographical and vertical limits of unmanned aircraft operations, independent of the performance capability of the aircraft itself. Geographic and vertical limiting of UAS should be required for all UAS that are not intended to "mix" with conventional aircraft or in the vicinity of airports and other sensitive areas, regardless of whether the UAS is flown for business or recreation. Until the FAA mandates the use of such technology, the effectiveness of this solution will be somewhat limited.

Unfortunately, a software-based solution such as geographical and vertical fencing will be subject to hackers, or those intent on defying the regulations. Attempts to defeat such technology must be viewed as a deliberate act intended to create a hazard in the NAS and dealt with accordingly. Intentionally operating any aircraft whether manned or unmanned, in an unsafe manner is not a hazard to be mitigated – it is a deliberately unsafe act that, like intentionally shining a laser at an aircraft, cannot be tolerated and must result in an appropriate civil and/or criminal penalty.

Summarizing ALPA's View on UAS Design, Certification, and Operations

The pressure for rapid integration of UAS into the NAS must not result in incomplete safety analyses or technologies prior to any authorization approvals to operate. The urgency to allow UAS into the NAS with immature technologies and lack of appropriate standards and certifications at this time should not encumber other NAS users with additional safety burdens. Standards and technologies for UAS must be in place to ensure the same high level of safety as is currently present in the NAS before a UAS can be authorized to occupy the same airspace as airlines, or operate in areas where UAS might inadvertently stray into airspace used by commercial flights. It is critical that the decisions being made about UAS

airworthiness and operational requirements fully address safety implications and complete interoperability functionalities (e.g., detect and avoid capability) of these aircraft flying in, around, or over the same airspace as manned aircraft and, more importantly, airline aircraft.

A well-trained and experienced pilot is the most important safety component of the airline system. The role of the pilot is a major area of concern within the UAS – and within the piloted-aircraft communities. UAS pilots should not be allowed to operate UAS in any commercial operation using non-licensed or private pilots.

It is impossible for a UAS pilot to react to anything other than an explicitly annunciated malfunction. A pilot on board an aircraft can see, feel, smell, and hear many indications of an impending problem and begin to formulate a course of action before even sophisticated sensors and indicators provide positive indications of trouble. This capability is necessarily lost without a pilot on board, so the margin of safety the pilot represents must be replaced by other means. UAS pilots should be trained, qualified, and monitored to meet the equivalent standards of pilots who operate manned aircraft in either private or commercial operations.

ALPA Recommendations Pertaining to UAS Design and Operations

1. A comprehensive, proactive UAS safety program should incorporate technology standards, safety analyses, certifications, and flight standards to ensure that introduction of UAS into the NAS will not degrade the existing NAS target level of safety.
2. Federal aviation regulations that specifically address UAS operators, operations, aircraft, and pilots must be developed. Any UAS-unique or UAS-specific regulations must be comparable and compatible with other existing regulations for other airspace users.
3. UAS are inherently different aircraft from manned aircraft and should be required to be equipped with safety-based technologies designed with both well clear and aActive collision avoidance functionalities at the heart of their system architectures to operate in normal and abnormal modes and conditions to maintain the current level of safety in the NAS.
4. Commercially operated UAS should be flown by pilots who hold a commercial license and an instrument rating to ensure the continuity of safety that now exists in the NAS.
5. Regulations containing certification standards, continuing airworthiness standards, and minimum equipment list requirements for UAS that are intended to operate commercially in the NAS must be developed.
6. Any person or persons in direct control of a UAS must be limited to the control of a single aircraft unless operations are conducted in special-use airspace.
7. Congress should work with industry stakeholders to develop an appropriate UAS integration funding mechanism.

Near-Term Call for Action: A Four-Part Solution

With the anticipated sale of 1 million UAS in the next 90 days, there is an immediate sense of urgency that must be considered. ALPA believes that a significant step toward the eventual solution to safely integrating UAS into the NAS includes four fundamental elements:

1. *Education:* Anyone who plans to fly UAS must understand the aircraft, the airspace, and the other aircraft that could be encountered while flying.

   In the case of UAS that might be flown for compensation or hire in civil airspace, the pilot must hold a commercial pilot certificate to ensure he or she possesses the appropriate skill and experience to meet safety standards designed to protect the flying public.

   Those flying UAS for recreational purposes must adhere to the FAA guidelines including potential minimum age requirements, keeping the UAS within line of sight, and flying at heights under 500 feet.

   ALPA urges Congress to provide definitive authority and remove any ambiguity about the extent to which the FAA has the authority to regulate sUAS operated for recreation and hobby. However, in the absence of congressional clarification, we believe FAA may be able to utilize its authority to ensure the safety of the national airspace by regulating all aircraft operations including recreationally flown UAS. ALPA stands ready to assist the agency in the swift development of these regulations and help achieve our shared goal of ensuring the safety of air transportation.

   Based on what the FAA has documented to date, the ongoing educational efforts under way by the FAA and recreational UAS segment are woefully inadequate. ALPA remains willing and able to assist.

2. *Registration:* Gathering basic information about the identity of the individual purchasing the UAS not only allows law enforcement authorities to identify the owner if the UAS were to encounter a problem, but it helps make clear the serious nature of operating a UAS in the U.S. NAS and the responsibility to safeguard public safety.

3. *Technology:* If UAS, either intentionally or unintentionally, are operated in airspace that airliners use, airline pilots need to be able to see them on cockpit displays, controllers need the ability to see them on their radar scopes, and UAS must be equipped with active technologies that ensure that the UAS is capable of avoiding collision with manned aircraft. In these types of operations, technology must enable the pilots to control and interact with them in the same manner as if the pilot were on board.

   If a UAS is restricted by regulations from operating in a particular geographic area and/or altitude, it must have technology that cannot be overridden that limits the geographic areas and altitude in which it can operate. This may include permanent locations such as the White House and all public airports, as well as temporary restrictions such as for wildfires or natural disaster areas.

4. *Penalties and enforcement:* UAS pilots must be properly trained and understand the consequences of possible malfunctions. Anyone flying a UAS that is a hazard to other aircraft in the airspace, especially those who choose to do so recklessly near airports, must be identified and appropriately prosecuted. We support the

criminalizing of intentionally unsafe operation of UAS and penalties for unintentional unsafe UAS operations. If additional funding is needed for this purpose, Congress should provide the resources needed without delay.

Conclusions

American aviation technology is experiencing its own "space race" akin to the 1960s. With phenomenal growth in aviation science and technological advancements in this modern digital age, the results are testimony to the advanced applications underpinning NextGen and associated programs. These technologies are designed at their core architectures to be safe, reliable, and repeatable to provide the efficiencies required to maintain the target level of safety as aviation transportation continues to grow.

The target level of safety for commercial air travel in the NAS should be proactively, not reactively, protected. We are fully aware that there is a strong desire by UAS proponents, and those who wish to become operators, to begin flying in the NAS as quickly as possible. Clearly, there are commercial, social, business, and international competitive advantages to a strong UAS industry. However, government and industry must take a longer view of this present state of technology to ensure that robust safety systems, in tandem with FAA-certified redundant systems of UAS, are developed that completely integrate with commercial airline operations and, above all, do so safely. An imprudent rush to create and implement minimum standards will not only harm safety, but potentially produce a setback for the future expansion of UAS operations for years to come.

Data show that UAS sales are skyrocketing while hazardous UAS encounters are also rapidly escalating. The need for immediate action is clear; but without comprehensive certification and operational rules and policies, the challenges we face will only continue to multiply.

On behalf of the more than 52,000 pilots whose top priority is safe transportation, we thank the committee for the opportunity to testify on this important subject and look forward to working together to ensure the safety of our air transportation system.

PREPARED STATEMENT OF RICHARD HANSON
DIRECTOR OF GOVERNMENT AND REGULATORY AFFAIRS, THE ACADEMY OF MODEL AERONAUTICS
U.S. House of Representatives
Committee on Transportation and Infrastructure, Subcommittee on Aviation
"Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems"
Wednesday, October 7, 2015

Chairman LoBiondo, Ranking Member Larsen and members of the committee, thank you very much for the opportunity to participate in today's hearing on aviation safety. I'm speaking on behalf of the Academy of Model Aeronautics (AMA), the world's largest community-based organization[1] representing those who fly small unmanned aircraft systems (sUAS), or model aircraft as we call them, for recreational and educational purposes. For nearly 80 years, we have been dedicated to promoting and preserving the hobby of flying model aircraft.[2]

We advocate for and support our more than 180,000 members and 2,400 chartered clubs across the country. The AMA provides leadership, organization, competition, protection, representation, education and scientific/technical development to the model aircraft community. The truth is that hobbyists have flown model aircraft since before manned aviation began. Hobbyists have over 100 years of experience flying model aircraft, and the hobbyist community has established a legacy of safe and responsible flying.

As you're well aware, we are currently seeing unprecedented growth in the development and expanse of unmanned aircraft. According to the Consumer Electronics Association, drone sales in the U.S. will reach 700,000 units in 2015 – a 63% increase from the previous year.[3] The growth in this technology and

[1] http://www.modelaircraft.org/uashearing-10-07-2015.aspx

[2] http://www.modelaviation.com/images/article/AMA75-ONLINESUPPLEMENT.pdf

[3] https://www.ce.org/News/News-Releases/Press-Releases/2015-Press-Releases/New-Tech-to-Drive-CE-Industry-Growth-in-2015,-Proj.aspx

the emergence of the supporting industry is exciting and extremely beneficial to our economy and our society as a whole. This technology brings with it beneficial applications in areas of exploration, preservation, conservation and humanitarian endeavors. Unmanned aircraft can also be extremely beneficial in the event of manmade and natural emergencies. This technology has the potential to improve our quality of life, to save lives, and to prevent injury in hazardous and perilous situations.

As with any emerging technology, the advent of UAS brings with it policy challenges. Challenges in terms of balancing safety, sustained industry growth, and public benefits. While technology solutions are important tools, enhanced educational efforts through community-based organizations, such as the AMA, as well as stricter enforcement of existing regulations and establishing the regulatory framework around commercial use of this technology, will make the greatest strides towards increased safety.

It's been suggested that technology itself can be the solution to the concerns relating to UAS. Although technology can certainly be part of the solution, relying solely on technology in a snapshot of time could ultimately have a stifling effect on future development and may prove to be ineffectual as new technologies emerge.

One of aviation's primary safety tenants is the final authority and responsibility of the operator to assure the safe operation of his or her aircraft. Relying solely on technology to ensure the safety of flight effectively shifts responsibility and accountability from the operator to the manufacturer and/or third party software developers. AMA strongly suggests that technological solutions be geared toward enhancing the operator's situational awareness and providing the information necessary to make informed and prudent operating decisions. Technology that overrides or impedes the operator's discretionary actions may have the effect of inhibiting legitimate operations, could inadvertently cause an unsafe operating condition and may ultimately hinder the operator's ability to manage an emergent situation.

To the industry's credit, many of the leading companies that manufacture unmanned aircraft for both recreational and commercial purposes have developed and implemented technology to address some of these issues and safeguard against the risks and threats we are all concerned about. These include

default altitude limitations and GPS-based information[4] (often called geo-fencing) to help prevent inadvertent flight by operators who may not be familiar with airspace restrictions. Industry innovations include an automatic return-to-home feature that engages when the command signal is lost or when the battery runs low. As circumstances and issues evolve, the industry is rapidly developing additional technologies to address safety and operational concerns, not only because it is in their interest but also because their customers are demanding these features.

While the use of this technology is gaining notoriety and has generated questions regarding safety and appropriate use of UAS, the traditional model aircraft community continues to operate recreational UAS in safe and responsible manner. AMA's members in particular have an unparalleled safety record. The Academy first began developing community-based safety guidelines[5] when it was founded in 1936, which actually predates the FAA by 22 years. These educational tools are critical for our members to learn and stay up to date about the safety aspects of operating their model aircraft. AMA's educational programs teach recreational users not to interfere with and to remain well clear of manned aircraft, to know where and when it's inappropriate to fly their model aircraft, and to notify airport authorities and air traffic control when flying in close proximity to an airport.

All of our members must fly their model aircraft in accordance with AMA's National Model Aircraft Safety Code[6] and affirm their voluntary compliance with the Academy's safety guidelines and those of their local flying site as a condition of membership. AMA's community-based safety program has been recognized by Congress as well as state legislatures as a safe and effective means of managing the operation of model aircraft and the activities of the aeromodeling community. The AMA has an infrastructure of organizational leadership and procedures that regularly reviews techniques, technologies, ideas and guidelines that would affect the safety of model aircraft use. This process keeps the safety code and modeler practices in sync with current practices and a changing regulatory environment.

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[4] See addendum A – DJI Safety Features

[5] http://www.modelaircraft.org/uashearing-10-07-2015.aspx

[6] http://www.modelaircraft.org/files/105.pdf

As a result, today AMA's safety guidelines continue to evolve to accommodate new technologies, new modeling disciplines, and a diverse community of model aircraft enthusiasts from six to 96 years old who safely enjoy this fun, educational hobby. AMA has always believed that the best, and perhaps the only, way to successfully manage the recreational community is through a community-based set of safety guidelines. This system has worked for decades, is working today, and should continue for many generations to come.

Protecting model aircraft enthusiasts is about much more than a hobby – model aircraft is also an effective teaching and career development tool. During the Apollo program of the 1960s, the average NASA engineer was in his or her late 20s. Today's average aeronautical engineer is in his or her mid 50s. Sadly, numerous technological innovations of today are developed outside the United States. The need is clear: America must foster a new generation of engineers, scientists, technologists, and skilled individuals who are relevant in the technology-based workplace.

And model aviation has long served as a stepping stone for these careers. The majority of America's civilian, military, and commercial aviators, as well as aviation professionals, report being influenced by model aviation early in life. Neil Armstrong, aviation pioneer Burt Rutan, and astronaut Robert "Hoot" Gibson—all lifelong AMA members—are just a few examples. Even "Miracle on the Hudson" Flight 1549 pilot Chesley "Sully" Sullenberger built model airplanes in his youth.

In support of the effort to foster a new generation of engineers, AMA as a national organization and our local chartered clubs across the country are involved in and support many science, technology, engineering and mathematics (STEM) projects. There's no doubt that model aviation is fertile ground for the innovations that will one day be tomorrow's technology. Consequently, we must be careful to protect the fun and educational hobby of model aeronautics.

Unfortunately, protecting the hobby of model aircraft is no easy task in today's regulatory and media environment. Drones, as UAS are commonly named, have become increasingly popular and readily available to the general public. Like many new technologies, this proliferation has created concern about safety.

Headlines from the last several months have reflected this increased focus on drones. Stories portray drones "clogging U.S. airspace," "snarling air traffic," "giving the FAA fits," and "penetrating some of the most guarded airspace in the country." As the largest national organization representing long-time hobbyists, we have been very concerned about these reports. Safety is the cornerstone of our organization and our members have been flying safely for many years.

In order to better understand the current state of drones in the United States, and what role we could play to help advance safe and responsible flying, AMA closely analyzed each of the more than 700 records of "drone sightings" released by the FAA this summer. Our analysis of the FAA's drone data reveals a very complex picture of drone activity in the U.S.[7]

Without a doubt, the FAA's data includes some records of "near misses" that represent actual safety concerns, and more needs to be done to address those. At the same time, our analysis shows that the number of "close calls" and "near misses" is substantially lower than the media headlines would suggest. While a single near miss involving a UAS is cause for concern, exaggerating and mischaracterizing the data makes it impossible to assess the magnitude of the situation and appropriately address the risks involved.

A closer look at the FAA's data reveals a hodgepodge of reports. First of all, not every sighting or drone report found in the data was truly a "close call." Many were just that – sightings. AMA's analysis of the data shows that only a fraction of the records were legitimately reported as "near misses" or "near mid-air collisions." In fact, only about 3.5 percent of the reports were identified with explicit notations as a "near miss" or a "near mid-air collision." According to the data, the number of encounters that pilots considered near misses was in the dozens, not the hundreds.

Some of the most serious incidents in the FAA's dataset – including two actual crashes – involve government-authorized military drones, not civilian drones. The records also include several reports of authorized or unauthorized public entities and commercial operators flying. Given the widespread

[7] http://www.modelaircraft.org/gov/docs/AMAAnalysis-Closer-Look-at-FAA-Drone-Data_091415.pdf

See also addendum B – "A Closer Look at the FAA's Drone Data"

interest in commercial applications, unidentified operators cannot and should not be presumed to be "hobbyists."

Some additional sightings appear to involve people flying unmanned aircraft systems (UAS) responsibly and within current recreational guidelines. And even more interesting, AMA's analysis found that many things in the air – from balloons and birds to model rockets and mini blimps – are mistaken for, or reported as, drone sightings even when they are not. Clearly, more analysis of the data is needed.

Before we move forward to address safety concerns, we must first do more to understand what is actually occurring in the nation's airspace. We believe the FAA's drone data could help guide future policy conversations on this issue, and help all stakeholders identify solutions to mitigate true safety risks. But this is only possible if the agency takes the time to analyze and accurately categorize the data.

AMA has worked closely with the FAA for many years, and we continue to consider the agency a partner in promoting model aircraft and consumer drone safety. While the FAA needs to do a better and more accurate job analyzing the problem, there are unquestionably some safety risks that deserve attention. And AMA has several recommendations for what we can do right now to ensure the continued safety of our nation's airspace.

One of the most immediate and helpful things the FAA can do to increase safety is to finalize and implement its small UAS rules. These rules have been long in coming and the FAA recently missed its congressionally-mandated deadline of September 30, 2015 to integrate unmanned aircraft systems into the national airspace. As they are currently written, the proposed rules will enhance safety by requiring everyone who wants to fly to either follow the safety programming of a community-based organization (CBO) like AMA or follow new FAA rules for commercial operators. Once implemented, the new rule puts in place some level of oversight and education for all sUAS operators.

At the same time, the FAA should step up enforcement of existing regulations and work more closely with local law enforcement to pursue bad actors. There are existing federal prohibitions against interference with manned aircraft operations, and regulations that address careless and reckless flight. The FAA has the authority to fine operators up to $25,000 for violations that rise to the level of

endangering persons and property.[8] In many jurisdictions, there are also criminal laws that address endangerment, public disturbances, and malicious activity under which irresponsible drone operators could be prosecuted. However, despite the FAA and local authorities having the ability to levy hefty penalties, very few enforcement actions have taken place.

AMA supports the FAA taking a more aggressive approach to enforcement against truly careless and reckless behavior. In AMA's analysis of the FAA's drone data, we also found that more than 140 drone sightings either weren't referred to local law enforcement at all or it is not known whether local law enforcement was notified.

While not every report is a serious safety risk, or even someone behaving irresponsibly, the only way to identify the truly careless and reckless UAS operators and to learn the facts about what happened is better communication and coordination with local law enforcement. Stricter enforcement and increased coordination with local authorities will go a long way to deter irresponsible behavior, and it's a step the FAA can take today.

The most meaningful step we can all take to address safety concerns is to increase education. AMA members, who have been flying for many years, know where and where not to fly, and do so safely and responsibly. Unfortunately, many newcomers to the technology may not be aware of the safety considerations involved in operating their unmanned aircraft or "drone". That's why AMA has expanded its educational efforts beyond its members to include newcomers to the hobby and those who might be purchasing a drone for the first time.

In December 2014, AMA launched "Know Before You Fly" along with the Association for Unmanned Vehicle Systems International (AUVSI), the Small UAV Coalition and in partnership with the FAA.[9] This education-focused campaign works to put important safety information and flying tips in the hands of new flyers. By working with manufacturers and distributors to include safety brochures in product packaging, at the point of sale and online, we are helping to ensure everyone has access to basic safety

[8] https://www.law.cornell.edu/uscode/text/49/46301

[9] http://knowbeforeyoufly.org/

information and operating guidelines. To date, six manufacturers and distributors – Castle, DJI, Hobbico, Horizon, Yuneec and UAV Experts – have agreed to include KBYF brochures with their products and more are joining each month. Many of the long-standing aviation association and industry advocates in both the manned and unmanned communities such as the Air Line Pilots Association (ALPA), which is also testifying alongside AMA today, Aircraft Owners and Pilots Association (AOPA), the National Business Aviation Association (NBAA), The Experimental Aircraft Association (EAA) and the Airborne Law Enforcement Association (ALEA) have signed on to the Know Before You Fly campaign and have agreed to help distribute the KBYF safety message.

AMA has also shared materials from the FAA, U.S. Bureau of Land Management and U.S. Forest Service – including the National Interagency Fire Center's public service announcement and the U.S. Forest Service's "If you fly, we can't" flyer – with our members who fly UAS for recreational and educational purposes. While our members already know not to fly in and around wildfires, we've asked them to help spread the message more broadly to non-AMA members who might not be as familiar with safety best practices. AMA also coordinated with the modeling industry to distribute these materials through the network of online distributors and the prominent display of safety posters at brick and mortar retail locations in the affected states.

These efforts are important steps toward increasing education for UAS flyers, both new and old, but it is not the only step we can take. The FAA must quickly finish the proposed UAS rules, more strictly enforce existing regulations, and increase coordination with local law enforcement. This will address many of the safety concerns we all have with drones.

AMA is fully committed to working with all stakeholders on these solutions and to ensure the safety of our airspace for all manned and unmanned aircraft. Thank you again for the opportunity to speak today. I look forward to answering any questions the subcommittee might have.

ADDENDUM

A – DJI Safety Features

B – "A Closer Look at the FAA's Drone Data"

THE FUTURE OF POSSIBLE

Safety Features Implemented in DJI Consumer Drones

- Live map showing drone location, orientation, distance, altitude
- Visual/audible low-battery warning with reserve power
- Altitude limitation (398 foot default)
- First consumer drone with geofencing – provides location-based warnings and, in some cases, restricts flight
- Automatic return-to-home in event of radio signal loss
- Automatic return-to-home in event of low battery
- Automatic user-initiated return to home in the event of any contingency
- Auto-land feature for all of the above return-to-home functions
- Talking voice feature for audible cues when pilot is looking up
- Prediction of battery power needed to return home (avoids "point of no return" problem)
- Motors do not spin until deliberate arming sequence is input by user
- Intelligent battery system with charge history and temperature monitoring
- Built-in flight simulator for practice
- GPS hold feature keeps drone in place even with pilot "hands off" or in wind
- GPS using two different systems for redundancy and reliability
- Vision positioning system for position-hold indoors or at low outdoor altitudes
- Speed limitation (Phantom/Inspire)
- Weak radio signal warning before signal loss
- Live HD view for collision hazard detection and precise positioning
- Auto-tightening or locking propellers eliminates loose ones flying off
- Propeller guards for Phantom series
- Lightweight materials and lowest-in-class drone weight to reduce risk
- Collision avoidance technology for the Matrice 100 (first "retail" drone to offer this)

A Closer Look at the FAA's Drone Data

From military crashes to a UFO sighting, AMA analysis reveals a more complex picture of drone activity in the United States – and only a small fraction were legitimately reported as "close calls"

Executive Summary

Headlines from the past few weeks are enough to make you rethink your summer vacation. "FAA records detail hundreds of close calls between airplanes and drones," proclaimed *The Washington Post*. "Leaked FAA report shows almost 700 close calls between drones and planes," wrote *The Christian Science Monitor*. Stories portray drones "clogging U.S. airspace," "snarling air traffic," "giving the FAA fits," and "penetrating some of the most guarded airspace in the country."

As a nationwide community-based organization of more than 180,000 model aviation enthusiasts, the Academy of Model Aeronautics (AMA) is deeply concerned about these reports. Safety is the cornerstone of our organization; our members have been flying model aircraft safely for nearly eight decades.

In order to better understand what's occurring, and what role AMA could play to help advance safe flying, our organization closely analyzed each of the more than 700 records of "drone sightings" recently released by the FAA.

Without a doubt, some drones are flying too close to manned aircraft, airports, wildfires, critical infrastructure and in restricted airspace. AMA is concerned about these reports and helped create the 'Know Before You Fly' (KBYF) campaign in 2014 to educate newcomers to drone technology about where they should and shouldn't fly. AMA and its partners continue to work with manufacturers and distributors to include safety brochures in product packaging and/or at the point of sale. To date, six manufacturers and distributors – Castle, DJI, Hobbico, Horizon, Yuneec and UAV Experts – have agreed to include KBYF brochures with their products and even more supporters in the manned and unmanned aviation communities are joining each month. Hobby People, a brick and mortar retailer, is displaying the KBYF materials at the point of sale in all 18 of their stores. DJI, which manufacturers the popular Phantom quadcopter, has also asked its sales dealers to distribute KBYF brochures with drone equipment sales, and has implemented altitude limitations and GPS-based warnings and limitations into its products.

Beyond education, AMA has encouraged the FAA to more aggressively enforce existing rules against careless and reckless behavior, as well as violations of restricted airspace. The FAA currently has the authority to assess civil penalties of up to $25,000 against careless and reckless operators. Hefty fines could help deter bad behavior, yet very few fines have been levied to date. While AMA's members are responsible and know where they should and should not fly, all users of the airspace have a responsibility to ensure safety, and AMA is committed to doing its part.

At the same time, AMA's analysis of the FAA data shows that the number of "close calls" and "near misses" is substantially lower than the headlines would suggest. So what's in the data? A closer look reveals a hodgepodge of reports. Some of the key takeaways:

- Not every sighting or report was a "close call." Many were just that – sightings. Only a small fraction was legitimately reported as "near misses" or "near mid-air collisions."

- Some of the most serious incidents in the FAA data – including two actual crashes – involve government-authorized military drones, not civilian drones.

- It's not just uninformed consumers causing problems; the records include several reports of authorized or unauthorized public entities and commercial operators flying. Given the widespread interest in commercial applications, unidentified operators cannot be presumed to be "hobbyists."

- Some sightings appear to involve people flying responsibly and within the FAA's current recreational guidelines.

- Many things in the air – from balloons and birds to model rockets and mini blimps – are mistaken for, or reported as, drone sightings even when they are not. One pilot in Minnesota even reported seeing something that "resembled a dog."

- A number of sightings have occurred over or around stadium events, wildfires, power plants and other critical infrastructure. These raise different concerns from pilot sightings.

- Despite the FAA's stated desire to find and punish rogue operators, in almost 20% of reports – 142 reports, to be exact – local law enforcement either wasn't notified or it was unknown whether local law enforcement was notified.

The following analysis delves into each of these findings in greater detail. Meanwhile, the conclusion contains recommendations for the FAA going forward, both in terms of how this data should be released in the future as well as what more can be done to address instances of irresponsible operations.

The majority of these reports are sightings. Only a few dozen are explicitly reported as "near misses" or "near mid-air collisions"

There's a big difference between a sighting and a near miss. Seeing a drone doesn't necessarily mean there was a "close call" or that there was any safety risk. We analyzed each of the FAA's 764 records in an attempt to discern the true "near misses" from what may be more appropriately be called "sightings." We tallied up the number of narrative reports that explicitly called an event a "near miss," "near collision" or NMAC (near mid-air collision). We also looked at when a pilot took evasive action to avoid a drone and when no evasive action was taken, or evasive action was unknown. Here's what we found:

- Despite the perception that all of the 764 reports are "close calls," we only identified 27 reports – or 3.5% – that had some explicit notation of NMAC, "near miss" or "near collision."

- Several reports explicitly indicate the opposite – that a pilot did not consider the event a near miss. These notations include:

    - "PILOT ISN'T REPORTING A NEAR MID-AIR"
    - "THE PILOT DID NOT CONSIDER IT AS A NMAC"

Since so few reports explicitly indicate whether a near miss did or did not occur, we drilled down further and examined how many pilots reported taking evasive action in response to a drone. The numbers are also surprisingly few:

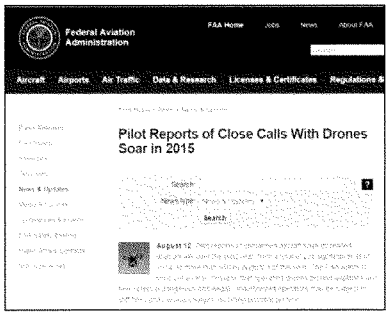
- In 51% of the records (392 or 764), there is an explicit notation of "No Evasive action taken," "Evasive action unknown" or a variation thereof.

- Only 1.3% of the records (10 of 764) explicitly note that a pilot took evasive action in response to a drone.

- The rest of the records do not address evasive action, conflicts or near misses at all, either because of an omission in the data or because the remaining reports do not relate to pilot sightings.

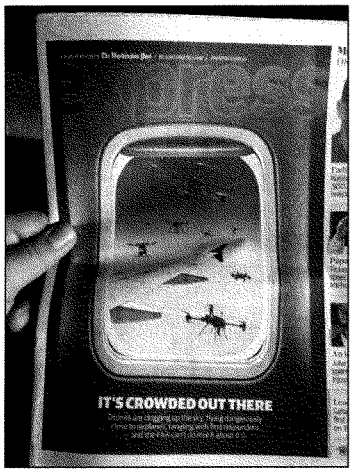
Evasive action taken?	Number of records	Percent of total reports
No evasive action taken or evasive action unknown	392	51.3%
No reference at all or not applicable	362	47.4%
Evasive action taken	10	1.3%

AMA's Recommendation(s): The FAA needs to better analyze and categorize pilot reports to indicate which present serious safety risks (near mid-air collisions) and which could be more appropriately classified as sightings. There are several issues with the FAA's handling of this most recent announcement of drone sightings.



First, the FAA fueled inaccurate and sensational headlines claiming that all drone reports involve "close calls," which even a causal review of the FAA's data shows is inaccurate.

This happened first and foremost because the agency's own press release from August 12, 2015, bears the headline, "Pilot Reports of Close Calls With Drones Soar in 2015" and the FAA cited more than 650 reports.[1] When the actual reporting data was released on August 21, the FAA's characterization changed dramatically to describe these same reports as merely "possible encounters." During that intervening two-week period, public opinion was influenced by media coverage that relied upon, and cited, the FAA's description of these 650 possible encounters as "close calls." These media reports have, in turn, been cited by lawmakers in Washington and in various states as a reason to call for new legal restrictions.



FAA's characterization of its data has led to sensationalized and inaccurate reporting, including in The Washington Post.

More recently, the FAA admitted in an August 30 news story that there is no regulatory definition for what constitutes a "close call." The agency said the phrase was "simply part of a news headline,"[2] implying that the agency may have intentionally used sensational language to spur media interest in its data. The general public, the media, our nation's lawmakers, and all stakeholders in drone technology deserve better from the government agency responsible for the safety of the nation's skies and for reporting objectively and accurately on public safety issues.

[1] http://www.faa.gov/news/updates/?newsId=83445

[2] http://www.journalnow.com/news/local/cloudy-faa-data-skews-drone-threat/article_80e10858-3fbb-51ba-827c-e5fb55a26534.html

Most importantly, the FAA's lack of analysis makes it more difficult for the broader community, whether recreational or commercial, to easily identify the most serious safety risks and work toward advancing solutions. There is a flattening of perception that every report is just as important as the next, which clearly isn't the case. Some reports in the data – where near misses occurred or when pilots took evasive action – deserve more attention than others.

Meanwhile, the release of preliminary, raw data without any analysis, context or investigative findings only tells part of the story. Presumably there are investigative findings and other information on at least some of these sightings that would shed light greater on their accuracy or legitimacy. The FAA should be more transparent with this information.

Military drones, not civilian drones, are involved in some of the most serious incidents, including all actual crashes

While civilian drones have been the focus of news reports, more than a dozen events in the FAA data involve military drones, or are very likely FAA-approved military drone operations. What's more, the incidents involving military drones are among the most serious in the data, including two actual crashes.

- On July 24, 2015, Lockheed Martin lost control of a small military drone in Owego, NY, prompting the operator to alert a nearby control tower to "watch out."
- On May 26, 2015, a Swedish Air Force C-130 climbed to avoid a military MQ-9 Reaper drone near Victorville, CA.
- On March 25, 2015, an MQ-1C military drone crashed near Wilsona Gardens, CA. The MQ-1C, manufactured by General Atomics, is reportedly an upgrade to the popular Predator drone.[3]
- In what may be the same event as above, on March 25, 2015, a citizen in Lancaster, CA reported that a "25 foot drone crashed" in a residential neighborhood. A photo was posted to the website of a local radio station.[4]
- On March 3, 2015, controllers at MacDill Air Force Base in Tampa, FL reported that a drone weighing "less than 300 pounds" crashed by the perimeter fence of the base.

While the incidents detailed above are among the most serious, there are several other reports involving military drones, or possibly military drones.

[3] http://www.ga-asi.com/gray-eagle
[4] http://www.kfiam640.com/onair/john-and-ken-37487/check-out-this-photo-of-a-13446744/

- A Cessna pilot in Van Nuys, CA reported a "huge, silver, military style UAS" which passed a few hundred feet overhead.

- A U.S. Army aircraft operating near Washington, D.C. reported seeing a drone that is "dark gray and smaller than a Predator."

- A VFR pilot in Anchorage, AK entered "hot" restricted airspace where a military drone was operating.

The number of reports involving military drones, or possible military drones, calls into question how many other reports in the FAA data may have been sightings of military aircraft. This is especially true of sightings at higher altitudes, including Class A airspace, which is the airspace between 18,000 feet and 60,000 feet above sea level. Reaching Class A airspace is generally beyond the capabilities of model aircraft and consumer-grade drones. Indeed, the most popular consumer drone sold today, the DJI Phantom, has a built-in maximum altitude function.

The FAA data includes reports of drone sightings at the following unusually high altitudes:

- 24,000 feet – July 24, 2015, near Colorado Springs, CO

- 51,000 feet – July 24, 2015 near Washington, D.C.

- 20,000 feet – March 5, 2015 near Los Angeles, CA

- 25,000 feet – February 9, 2015 near Teterboro, NJ

- 25,500 feet – February 9, 2015 near West Palm Beach, FL

- 19,000 feet – November 24, 2014 near Beaumont, TX

To put these reports into context, many small manned aircraft cannot even reach these heights. For example, the service ceiling – the maximum achievable altitude – of a single-engine Cessna Skyhawk (C172) is 14,000 feet.[5] Likewise, the maximum operating altitude of a manned Robinson R22 helicopter is 14,000 feet.[6]

AMA's Recommendation: The FAA should separate out reports that involve military or government agency-operated drones, or that likely involve such drones, from future drone sighting data. This could either mean excluding these military reports entirely, or explicitly indicating when the report relates to military use, and not civilian use, of a drone. These incidents should not be included in reported numbers of civilian drone sightings.

[5] http://cessna.txtav.com/single-engine/skyhawk
[6] http://www.robinsonheli.com/rhc_r22_beta_ii.html

There are public entities and commercial operators in the FAA's reports too

The FAA currently prohibits commercial drone use unless the operator has received a Section 333 exemption to fly. Likewise, public entities wanting to fly drones – including publicly funded universities, law enforcement agencies, fire departments and other government agencies – can do so by applying for a Certificate of Waiver or Authorization (COA) from the FAA. Despite the perception that all irresponsible operators are uninformed consumers or recreational users, the FAA data reveal several instances of public entities and commercial operations – some or all of which may have been unauthorized.

- In perhaps the most surprising example, on August 18, 2015, the Los Angeles Police Department notified the Inglewood Police Department that a drone the latter agency was flying over a crime scene "needed to come down." The drone was flying two miles from the approach end of a runway at LAX.

- On August 5, 2015, the Coast Guard in Mobile, AL reported a drone being used to film a commercial for a car dealership, in close proximity to the Mobile airport. The report notes that the company involved "does not appear to have a section 333 exemption."

- On August 2, 2015, authorities in Pomona, CA observed a drone flying over a concert, ¼ mile from a nearby airport. The report states the drone was operated by the event host, Live Nation.

- On July 7, 2015, a pilot in Redding, CA reported a drone ¼ mile from the runway of a local airport. Local police verified that the drone was being operated by a construction company, which was advised to cease operations.

- On April 28, 2015, a local photography and marketing business in Winchester, VA was reportedly hired to capture aerial photos of the Shenandoah Apple Blossom Festival. The same company may have also used a drone to produce a public service announcement for the Winchester Public Schools. The company does not appear to have FAA approval to fly. Meanwhile, the superintendent of the Winchester Public Schools said the business owner, "does this all the time."

Whether innocent or intentional, there are some public entities and commercial operators in the FAA's data. Meanwhile, as with the military reports, the presence of several clearly identifiable public entities and commercial operators in the reports raises questions about how many other drone sightings may be authorized or unauthorized public entities and commercial operators. All of the sightings like these have been inaccurately and unfairly characterized by the FAA as "hobbyist" operations, when clearly not all are.

AMA Recommendation(s): As with military reports, the FAA should clearly separate out and explicitly indicate reports that are public entities and commercial operators, or very

likely public entities and commercial operators. In the absence of any operator identification, and given the heightened interest in commercial applications, it is inappropriate to assume, or to report, that a drone was operated by a "hobbyist."

Meanwhile, the FAA needs to finalize its small UAS (drone) rules without any further delays. Congress directed the FAA to put these rules in place by September 30, 2015, a deadline the agency is likely to miss. The faster these rules are finalized, the faster public entities and commercial operators will have a regulatory framework with clear requirements in which to operate. Rules won't just help public entities and commercial operators; they will enhance safety across the board by requiring everyone to follow either the new rules for commercial operators or the safety programming of a community-based organization (CBO), like the AMA.

Some drone flyers appear to be following proper recreational guidelines, yet they are reported anyway

One of the more surprising findings in the FAA data is the discovery that, in at least half a dozen instances, some drone flyers may be following FAA-endorsed recreational guidelines. Yet, these users are reported and included in the FAA data set because of a citizen or pilot who is unfamiliar with the proper guidelines.

The FAA has indicated that recreational flyers should stay below 400 feet, stay well clear of manned aircraft, fly their drones or model aircraft within visual line of sight at all times and not fly within five miles of an airport without prior notification to the airport operator or air traffic control tower (when an air traffic facility is located at the airport). Below are examples of reports that appear to meet these guidelines:

- On July 24, 2015, a "low flying" drone was reported five miles south of the Leigh Valley International Airport in Allentown, PA. No specific altitude was reported.
- On June 10, 2015, a helicopter flying "below 500 feet" reported seeing a drone five miles away from Fort Lauderdale-Hollywood International Airport.
- On April 28, 2015, a 9-1-1 caller reported a drone 13 miles from Chicago Midway International Airport. The caller stated the drone was "not high."
- On March 28, 2015, a resident of Sioux Falls, SD reported a drone flying "around the area...at 400 feet."
- On February 14, 2015, a drone was reported "below 400 feet" in the vicinity of downtown Anchorage, AK.
- That same day, a helicopter reported a drone 6.5 miles away from Miami International Airport at an altitude of "400-500 feet."

- Also in Miami, on December 14, 2014, a helicopter pilot reported a drone at 150 feet, 5 miles from Miami International Airport.

These are just some of the reports that may actually be cases of safe and responsible operators who are flying within the FAA's current guidelines. There may be many other operators following the guidelines in the data set, but it's difficult to discern because of the two different ways altitudes are reported.

When pilots report drone sightings, they typically report the MSL (mean sea level altitude) of their aircraft along with the sighting. That's because altimeters in manned aircraft measure altitude above sea level.

Drone enthusiasts on the ground are advised to stay under 400 feet AGL (above ground level).

At sea level, 400 feet MSL equals 400 feet AGL. As a practical matter, the ground elevation of most places in the country is higher than sea level, especially in western states. This means that, to get a true picture of how high a drone may be flying above its location, one needs to subtract the ground elevation from an altitude report given in mean sea level.

Consider the following hypothetical example. A drone enthusiast flying six miles away from Denver International Airport (DEN) believes he is following all of the appropriate recreational guidelines, including staying below 400 feet. Meanwhile, a pilot landing at DEN reports a drone off in the distance at 5,700 feet. Is this operator doing something wrong?

No. The pilot is reporting his altitude above sea level, 5,700 feet. The field elevation of the Denver airport is 5,327 feet. That means that the drone is actually flying at 373 feet above ground – under 400 feet. In this instance, there is no "close call" and no danger to the manned aircraft, it is merely a reported sighting of a drone operation that is in compliance with FAA guidelines, which include the instruction that drones should yield right of way to manned aircraft. The direction to yield right of way necessarily means that drones and manned aircraft will be visible to each other's pilots, and that sightings will occur and will be reported.

AMA Recommendation(s): First and foremost, the FAA should exclude from its records any reports where the operator is following, or very likely following, recreational guidelines. There are at least a few of these. By including these reports – and only including preliminary data – the agency is essentially considering all drone operators guilty until proven innocent. The presumption is, if someone sees a drone and makes a report, the drone operator is automatically doing something wrong, which isn't always the case.

These reports also underscore the problems with preliminary data. Some of the reports noted above, as well as others in the data set, may later have been investigated and found to be safe and/or appropriate flights. But the public doesn't know if that's the

case because no investigative findings are being released. As stated previously, the FAA needs to be more transparent and release more information, not less.

Finally, in keeping with greater transparency, the FAA needs to clear up the ambiguities in altitude reporting going forward. Specifically, AMA would like to see any altitudes for drone sightings reported in AGL altitude, in addition to the MSL altitudes reported by some pilots. This conversion could be done, or at least approximated, by using the field elevation of the nearest airport. It is also important for pilots to be prompted to include in their reports the estimated altitude of the drone they have observed, not just their own altitude.

Drones are the new UFOs...except for one report of an actual UFO

In more than a dozen FAA records, pilots either reported seeing "something" other than a drone, or a pilot was unsure whether an object was a drone at all. Such an object is, quite literally, an unidentified flying object ("UFO"). However, it seems the term "drone" has become the new UFO, applying to everything from balloons and birds to model rockets and mini blimps. A few examples:

- On August 12, 2015, a pilot in Salt Lake City, UT reported seeing "an ultra light or drone type aircraft."
- On July 19, 2015, ground personnel at JFK in New York reported a cluster of silver balloons blowing over the airport fence. Controllers in the tower also noted seeing "a silver object."
- Also at JFK, on July 10, 2015, a JetBlue pilot reported seeing "a fast moving gray object."
- On July 5, 2015, an American Airlines pilot near LaGuardia Airport in New York reported seeing a "model rocket" at 2,800 feet.
- On May 31, 2015, a Quantas pilot reported seeing a "mini blimp" at LAX in Los Angeles.
- In one of the more ambiguous reports, on April 5, 2015, an Alaska Airlines pilot near Des Moines, WA "reported seeing something below" his aircraft.
- In what could have been a sighting of a manned aircraft, on February 10, 2015, a Southwest Airlines pilot reported seeing an "unidentified helicopter" while on final approach to LAX in Los Angeles.
- On November 30, 2014, a plane landing at Andrews Air Force Base outside of Washington, D.C. reported seeing a drone that looked like a "large vulture."

There are several more reports that indicate that pilots, at times, aren't sure what they're seeing. "Pilot was not positive that the object he saw was a drone" reads one entry from Sarasota, FL. A pilot in Georgia reported seeing "a red UAS (or balloon)." Similarly, a pilot near San Francisco, CA reported "a UAS or balloon at 10,000 feet."

A UFO Sighting?

"A/C REPORTED A UFO AT 150NM NORTH OF SWL APPROXIMATE FL510 MOVING FROM WEST TO EAST JUST ABOVE HORIZON WITH STEADY LIGHT ILLUMINATION. FAST MOVING DUE EAST GONE WITHIN 5 MINUTES. AVA020 CONCURRED WITH THIS REPORT. REPORT TO HQ/DEN."

While any object in the sky seems to be reported as a drone, occasionally a UFO is still a UFO. On July 24, 2015, two aircraft near Washington, D.C. spotted what they describe as a UFO at 51,000 feet – higher than commercial airliners typically fly.

Even airline pilots who fly very close to these "UFOs" can misperceive what they are. In one report, an airline pilot reported that his aircraft had actually collided with a drone and created sparks. Upon landing, an investigation revealed that his aircraft had actually collided with a bird. With approximately 10 billion birds in the United States, and with many birds presenting an anatomical shape in flight that is similar to the "X" shape of a quadcopter drone, it is quite conceivable that at least some of these reports are actually bird sightings.

It is also apparent that the FAA's reporting system reflected in the summary spreadsheet released to the public on August 21 is not always accurate or complete. For example, the spreadsheet indicates that on January 31, 2015, the pilot of United flight 1087 on approach to Boston's Logan Airport "REPORTED SEEING A UAS 100 FEET ABOVE ACFT ALTITUDE OF 7,000 FEET FOOTBALL SHAPED RED-BLUE IN COLOR." However, the ATC audio recording indicates that the pilot actually reported: "I don't know if it was a balloon or a drone."[7] The FAA's spreadsheet omits any mention of the possibility that this object was a balloon, even though the shape, altitude and pilot's audio recording all point to that as the more likely explanation. This misreporting by the FAA's own system suggests a bias towards reporting flying objects as drones even when the existing evidence indicates otherwise.

AMA Recommendation(s): The FAA shouldn't include reports of flying objects that are clearly not drones – balloons, model rockets, birds, etc. - in its data. The FAA should also separate out and clearly identify reports that are ambiguous – something below the aircraft, dark gray object, etc. – or which express doubt as to whether a flying object is, in fact, a drone. The report should include all facts as reported by the pilot to ATC, FAA or the airline, including any uncertainty about the object that was sighted.

[7] http://www.wcvb.com/news/drone-sighted-by-pilot-landing-at-logan/31035050

The data isn't all about pilots and airliners. People are flying over stadium events, wildfires, power plants and other places that may raise different concerns

While the FAA's press release and subsequent news coverage of the drone data focus on pilot reports and airliners, we have identified at least 26 records of drones flying near stadium events, wildfires, critical infrastructure and in restricted airspace. While these are potentially objectionable if unauthorized, they are certainly not "close calls" when no other aircraft is reported in the area.

Drones over stadiums

According the FAA data, drones have been sighted over the following stadiums and event venues, in some cases more than once:

- University of Alabama Stadium, Tuscaloosa, AL
- High School Football Stadium, Glendale, AZ
- Levi's Stadium, San Jose, CA
- Stanford University Stadium, Stanford, CA
- Nationals Park, Washington, DC
- Marlins Park, Miami, FL
- Fenway Park, Boston, MA
- Bank of America Stadium, Charlotte, NC
- Citi Field, New York, NY
- PNC Park, Pittsburgh, PA
- Seahawks Training Camp, Renton, WA

SOURCE: FAA database on Pilot UAS reports

For stadium events, wildfires and VIP movements, the FAA typically issues temporary flight restrictions (TFRs) that limit access to the airspace for both manned and unmanned aircraft.

For example, the FAA restricts flights over stadiums during Major League Baseball games, National Football League games, NCAA games and motor speedway events. The so-called "stadium TFR" prohibits aircraft operations at or below 3,000 feet AGL within a three nautical mile radius of any stadium with a seating capacity of 30,000 or more. The TFRs go into effect one hour before the scheduled event time and last until one hour after the event concludes.

Specifically, our analysis found:

- At least six reports of drone activity in and around Washington, DC's restricted airspace, including drones incidents at the White House that have been the subject of extensive media coverage.

- In another instance of a security breach, the Coast Guard reported a drone in the vicinity of the President playing golf in West Palm Beach, FL.

- At least 13 sightings involve stadiums or large event venues. However, it is often not noted whether a TFR was in place at the time of the report.

- There are at least four reports of drones flying near power plants in Maine, Wisconsin and

New Jersey. It is not clear whether these flights raise an actual safety or security concern.

- There are at least two reports of drones interfering with wildfire operations in California, which have also been the subject of extensive media coverage.

AMA Recommendation(s): While some of these sightings are likely more serious than others, they all speak to the need for greater education so that people aren't flying where they shouldn't. The reports of drones flying around wildfires are among the more serious and AMA has been working closely with the U.S. Forest Service and the Bureau of Land Management (BLM) to distribute educational materials including the U.S. Forest Service's "If You Fly, We Can't posters," to hobby shops out west.

Meanwhile, stadium events are clearly an attraction to drone flyers. At the same time, it is not immediately clear how many of these flights may have violated temporary flight restrictions. Going forward, the FAA should explicitly note whether a TFR was in place during a report that involves a stadium. More broadly, the FAA should identify and separately categorize all events that are, or are very likely, violations of TFRs and other restricted airspace. Despite the concerns these reports might raise, they should not be included in the same category as sightings by pilots.

A large number of reports aren't even referred to local law enforcement

The FAA has said in recent media reports that it is working closely with local law enforcement to identify and investigate reports of unauthorized operations. At the same time, our analysis of the FAA drone data finds that almost 20% of reports – 142 in total – either were not referred to local law enforcement or it is unknown whether a report has been referred to local law enforcement.

142

The number of drone reports not referred to law enforcement, or law enforcement notification is unknown

These reports bear notations such as:

- "NO LEO NOTIFIED"
- "LEO NOT NOTIFIED"
- "UNKN IF LEO NOTIFIED"
- "NO REPORT OF LEOS WERE NOTIFIED"

While the FAA has said that identifying rogue operators is a challenge, in a sizeable number of cases, the agency isn't even attempting to do so. The reasons for this aren't immediately clear. In one instance, a report notes that an incident occurred in Bahaman airspace and therefore law enforcement wasn't notified. However, in the vast majority of these 142 records, no explanation is given. Without such referrals, the possibility of learning the facts concerning these "possible sightings" is virtually zero.

AMA Recommendation(s): The AMA has been calling for more aggressive enforcement of careless and reckless operators and therefore urges the FAA to, as a starting point, report all instances of potentially irresponsible behavior to local law enforcement for further investigation. Our analysis has shown that not all of these reports are equally serious, and some reports may actually be people flying responsibly. That said, it is clear that greater communication and coordination between the FAA and local law enforcement is needed to identify and hold accountable operators who pose a danger to the national airspace system.

Conclusion

A close examination of the FAA's drone data reveals a much more complex picture of drone activity in the U.S. There are pilot reports of near misses that represent actual safety concerns, and more needs to be done to address these. But contrary to the FAA's assertion in its press release of August 12, and the widespread media reporting that followed, the narrative descriptions and notations in the 764 reports suggest that the number of actual "close calls" appears to be in the dozens, not the hundreds.

Moreover, the assumption that all drone flyers are "hobbyists" or recreational users is clearly inaccurate. As noted in this analysis, there are several instances of military sightings and mishaps, including two actual crashes. There are also public entities and commercial operators flying with or without authorization. When the operator is not identified, it is not possible to determine the purpose of the operation. Further, some reports may actually be drones operating responsibly pursuant to FAA guidelines, and some reported sightings of drones may not even be drones at all.

There is some useful information in the FAA's dataset – data that could help guide policy conversations about drones and help all stakeholders identify solutions to mitigate true safety risks. But the data is only useful if the FAA takes the time to analyze and accurately characterize it; the same holds true for the media and others.

While AMA works closely with the FAA, and we continue to consider the agency a partner in promoting model aircraft and consumer drone safety, the FAA mishandled the release of its drone data. The agency used misleading language in its press release, released only preliminary reports and did not critically analyze those reports. The agency should not have asserted in the media that there are hundreds of reports of "close calls" with drones when that is not supported by the data, and the agency admits that it has no regulatory definition of what constitutes a "close call."

Moving forward, AMA has two sets of recommendations – one set of recommendations relating to the FAA's handling of its drone data, and another set of recommendations to ensure the continued safety of the U.S. airspace.

Data recommendations:

1. **Don't just release raw reports or summary numbers; analyze all future drone data.** The AMA believes the FAA needs to conduct an analysis of all future data releases in order to more accurately portray what is happening. AMA recommends that these reports need to be better categorized going forward to highlight the most serious safety risks so that all stakeholders can work together to address them. Some of the categories or filters AMA recommends include:

    - Near misses / near mid air collisions
    - Sightings / not reported as a near miss
    - Military reports / reports involving military or government agency drones
    - Commercial reports / reports involving commercial use
    - Potential violations of TFRs or other restricted airspace
    - Note which reports are airborne pilot reports vs. ground reports

    Additionally, reports relating to balloons, UFOs, model rockets and other flying objects should not be included in the drone data.

    In addition to better categorizing the reports, the AMA urges the FAA to provide greater context for these reports, which includes:

    - Computing the approximate AGL (above ground level altitude) of any drone reports that are stated in MSL (mean sea level) altitudes.
    - Cross-referencing stadium reports with past TFRs (temporary flight restrictions) and explicitly noting whether a TFR was in effect during a stadium-related sighting.

2. **Release not just preliminary reports or numbers, but also investigative findings and any other information.** The problem with preliminary reports is just that – they are preliminary. Once investigated, the reports may turn out to be accurate. However, there's reason to believe that some may be inaccurate. While the FAA only released the preliminary data to the public, *The Washington Post* reportedly obtained some investigative findings. In one instance, a pilot reported hitting a drone, only later to determine that it was a bird. *The Washington Post* on August 20, 2015 reports:

    > *On May 9, the pilot of United Airlines Flight 863 — traveling from San Francisco to Sydney — reported that the Boeing 777 hit a drone at an altitude of 3,000 to 4,000 feet along the California coast.*
    >
    > *"Sparks were observed after contact," according to the FAA report, which said the 777 kept flying because it did not appear to be damaged. A United spokesman said it was later determined that the plane had hit a bird, not a drone.*

    This incorrect report, from a pilot who was close enough to actually see the object his aircraft collided with, is a good example of why initial reports cannot be relied upon to draw conclusions that might influence policy decisions. The general public, the media, lawmakers, and drone stakeholders deserve greater transparency.

Policy recommendations:

Safety is a top priority for the AMA. Our members have been flying model aircraft safely for nearly eight decades and want to see everyone embrace new drone technology safely and responsibly. While our analysis finds several serious issues with the FAA's data, we are aligned with the FAA when it comes to promoting the safety of the nation's airspace. In light of some of the reports that may constitute careless and reckless behavior, AMA recommends the following:

1. **Refer all reports to local law enforcement.** As noted in our analysis, more than 140 reports either weren't referred to local law enforcement or it is not known whether local law enforcement was notified. While not every report is a serious safety risk, or even someone behaving irresponsibly, the only way to identify the truly careless and reckless operators, and to learn the facts about what happened, is better communication and coordination with local law enforcement.

2. **More aggressively enforce existing rules.** There are existing federal rules against careless and reckless operations, for which the FAA can fine operators up to $25,000. In many jurisdictions, there are also criminal laws under which careless and reckless operators could be prosecuted. Despite the FAA having the authority to levy hefty penalties, very few fines have been assessed to date. AMA supports the FAA taking a more aggressive approach to assessing civil penalties against operators who endanger the safety of the national airspace system.

3. **Finalize the small UAS rules.** One of the most immediate things the FAA can do to increase safety is to finalize its small UAS rules. The draft rules will enhance safety by requiring everyone who wants to fly to either follow the safety programming of a community-based organization (CBO), like AMA, or follow new FAA rules for commercial operators. Once this happens, everyone would need to have some level of oversight and education in order to legally fly. These rules have been delayed several times and, in all likelihood, the FAA will miss its congressionally-mandated deadline of September 30, 2015 to issue final rules.

4. **Continue to educate new users.** Many of these reports underscore the need for more education of newcomers to the technology who aren't traditional model aviation enthusiasts and who aren't trained aviators. AMA is committed to continue advancing safety education under the "Know Before You Fly" campaign along with its campaign partners the Association for Unmanned Vehicle Systems International and the FAA. The FAA itself encourages model aircraft operators: "Do take lessons and learn to fly safely."[8] One of the keys to this commendable suggestion is to recognize that compensation of an instructor's time that is spent helping someone learn how to operate a model aircraft or recreational drone must not be viewed as commercial operation of a UAS requiring a Section 333 exemption and pilot certificate.

[8] https://www.faa.gov/uas/publications/model_aircraft_operators/

Testimony of Mykel Kochenderfer
Assistant Professor of Aeronautics and Astronautics
Stanford University
on

Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems

before the Subcommittee on Aviation
Committee on Transportation and Infrastructure
U.S. House of Representatives

October 7, 2015

Chairman LoBiondo, Ranking Member Larsen, and Members of the Subcommittee:

Thank you for the invitation to appear before you to discuss the risks associated with unmanned aircraft, also commonly called drones, in the United States.

I am a professor in the Department of Aeronautics and Astronautics at Stanford University and a third-generation pilot. In this testimony, I am speaking solely for myself.

My research for nearly ten years has involved statistical estimation of risk and the development of technology for enhancing aviation safety. While at MIT Lincoln Laboratory, I helped develop a collection of airspace models, jointly funded by the FAA, DHS, and the Air Force. These models have since been used to estimate collision risk for manned and unmanned aircraft by government, academic, and commercial organizations around the world. My work has also led, in part, to the technology underlying the FAA's next generation collision avoidance system called ACAS X that is currently undergoing international standardization. The FAA is developing a version for unmanned aircraft. My students at Stanford have been supporting this effort and the effort of NASA to build a UAS Traffic Management (or UTM) system.

Personally, I find the rapid acceleration of unmanned aircraft technology to be the most exciting recent development in the field of aeronautics. As we heard in previous panels, this wave of technology has the potential to save lives and create jobs. Few things are as beautiful as flight, and the proliferation of unmanned aircraft has made aviation accessible and inspired a generation of eager university students in a way we have not seen for a long time. It is no surprise that the growing popularity of these vehicles has also raised concern about the safety to other aircraft and the potential for interference with such operations as firefighting and air ambulances. There has been tremendous media coverage of these risks.

I hope to inform the discussion with my thoughts with respect to two questions. First, how do we measure and analyze these risks? Second, what are the best technologies and policies to mitigate these risks?

There is tremendous diversity in unmanned aircraft. We have very small aircraft such as the robot bee developed at Harvard University that weighs about the same as the average honey bee. We also have very large aircraft that are used primarily by the military. I do not believe that this hearing is especially concerned with the risks posed by the extreme ends of this spectrum. Rather, I believe we are concerned with and should be concerned with consumer drones that weigh a couple pounds or more. Drones much lighter than this do not represent true aviation safety hazards due to their physical inability to enter their airspace.

To answer the first question of how to measure and analyze the safety risk of consumer drones, we must have the understanding that risk is determined by both the likelihood and the severity of different hazards.

First, let us consider severity. A sufficiently large drone can cause damage to any part of an aircraft, but one of the most severe hazards is engine ingestion. We all recall the US Airways flight in 2009 that was struck by multiple Canada geese, leading to failure in both engines at takeoff and an emergency landing on the Hudson river. Of course, a flock of sufficiently large drones could cause similar damage. However, flocks of drones are rare; they are typically operated individually. In addition, most consumer drones, such as the DJI Phantom, are only one-third the weight of an average Canada goose. I am not aware of any engine ingestion testing of the Phantom, but it is certainly conceivable that it could cause some degree of damage to an engine but likely not of the severity of what occurred with the US Airways flight.

What is the likelihood of a mid-air collision involving a drone? In order for a collision to occur, the drone needs to be at the same altitude and in the same location as another aircraft. An analysis of radar data indicates that there are large portions of the United States where the risk of encountering another aircraft is negligible at the altitudes a small drone is capable of flying. However, there are portions of our airspace where the likelihood of a collision is orders of magnitude more significant.

Since it is in their interest to prevent accidents, some drone manufacturers, but not all, have been implementing altitude limits and geofencing. Geofencing uses GPS location to help prevent drones from flying in certain geographic areas, such as near airports and over national parks. For some drones, altitude limits and geofencing may be hard constraints representing areas where the drone will not function. For other drones, these constraints are presented as warnings and can be overridden by the operator. In addition to integrating altitude limitations and geofencing into drones, the drone industry has been working with the FAA to educate the public on the safe operation of drones.

In assessing the likelihood of collision with these mitigations in place, it is helpful to break the risk down into four categories of user: the conscientious user, the naïve user, the reckless user, and the bad actor. I will not discuss the bad actor here because this category is unlikely to be significantly impacted by legislation, though I do appreciate that there is a threat it could provide in the future.

First, the conscientious user is one who strives to operate within the altitude limits and geofences and diligently follows FAA guidance and regulation. For this category of user, the likelihood of collision can be quite low. The altitude is measured by a barometer. Failures in the barometer are exceptionally rare. Errors in the estimation of the geographic location are much more common. However, the system can be engineered in a way to help prevent unexpected "fly aways" where the aircraft departs the operating region. For example, in the event of loss of or errors in GPS or the radio control system, the system can be programed to either return to base or to land slowly. In the drones I am aware of, they are designed to only decrease altitude, never increase altitude, in the case of a fault. The likelihood of different failure modes might be estimated to some extent from service call data from vendors.

Second, the naïve user is one who may not be aware of the FAA guidance and regulations. They may receive their drone as a gift and may have noticed something about "know before you fly" packaged up with their drone, but they have no clue on how to estimate an altitude of 400 feet and they might not be aware that they are within a couple miles of a small general aviation airport. If their drone does not have at least a default altitude limit or geofencing, this can result in a safety risk far beyond that posed by the conscientious user. For decades, aircraft modelers and enthusiasts have maintained an exceptional safety record and the community has largely consisted of conscientious users. However, with the mass production of prebuilt consumer drones, many believe that the composition of the community is likely to change and will include a greater proportion of naïve users. The risk presented by these users may be mitigated by education and technology features that provide pertinent information at the time of operation.

Third, the reckless user is one who is aware of regulations but, for example, cares more about capturing a photograph or video than the safety of others. They are not bad actors who are acting primarily to harm others, but they can still pose significant risk. They might ignore or disable altitude-limits or geofences if made easy by the manufacturer, but they generally would not have the capability to reprogram the firmware or modify the hardware to override safety features.

It may be tempting to use the FAA database of alleged pilot sightings of drones to arrive at a quantitative measure of risk. However, as the Academy of Model Aeronautics has observed, many of the sightings are likely military aircraft or recreational aircraft operated legally and safely. It is also possible that some of the sightings were birds. I suspect that some of the pilot sightings involve drones flown by reckless users, but it is difficult to tell since the database does not include details of follow-up investigation. In addition to the potential for the database to lead to an overestimate of risk, there is also the potential to underestimate risk. Many drones are very difficult to see. As a pilot, I know that even conventional manned aircraft can be difficult to see, and so it is possible that there have been potential incidents that went unreported. Although the database of reports is helpful in drawing attention to potential hazards, it does not allow us to precisely measure risk.

Now, the second question: what are the best technologies and policies to mitigate these risks?

There are several technologies to help mitigate risk. I have already mentioned altitude limitations and geofencing. Altitude limits can be implemented fairly reliably and only require a barometric altimeter. A barometric altimeter measures pressure altitude at takeoff and the drone's software can make sure that the altitude of the vehicle not exceed some threshold above that. Of course, if you take off at the top of a mountain, you may be able to go to an area where you are well over 400 feet above the ground. There is not much you can do about this unless your drone is equipped with a terrain database or a laser altimeter. Implementing geofencing is even more difficult because it requires an up-to-date database of geofenced locations and accurate GPS position information, but the safety risk can be significantly reduced with such technology.

Altitude limitation and geofencing technologies are available today and implemented on many of the commercial drones, but should they be mandated? If so, in what form? I am not a policymaker, but I believe it would be wise to establish default altitude limits for non-toy drones capable of flying above 400 feet. The cost to add this safety feature if it does not already exist is fairly negligible. Most drones capable of flying above 400 feet already have an altimeter. One of the first things a new user might be tempted to do after opening the box is see how high the drone can go. A default altitude limit will not ensure safety or prevent interference with firefighting on its own, but it will certainly help naïve users and discourage reckless users. However, prohibiting a conscientious user from overriding the altitude limit is problematic. For example, authorized users such as firefighters might need to go above 400 feet in order to collect imagery of the wildfire they are fighting. The exact approach for overriding limits is still being thought through by industry, and I believe it is too early to mandate a particular mechanism. You do not want it to be especially easy for a casual user to dismiss altitude limits. An altitude limit for an appropriate category of aircraft that can be overridden in some way by a competent operator can go a long way in reducing risk.

Geofencing is more complicated and there are many cases where you may want it disabled. For example, some of my students were authorized to fly drones within a netted cage right next to Moffett Federal Airfield during a convention at NASA Ames on unmanned aircraft. If a geofence were strictly mandated, they would not be able to perform their demonstration. Similarly, fire fighters within an emergency temporary flight restriction should have access to drone technology. Appropriate users need the ability to

override geofences. How to determine whether a user should be permitted to override a geofence is unclear and raises complicated questions. A basic geofencing capability implemented by drone manufacturers with the capability of user overrides would help prevent unintentional airspace violations.

Altitude limitations and geofences are near-term risk mitigation measures, but it is becoming clear that some kind of infrastructure will be needed to facilitate the integration of commercial drones into the airspace to support applications such as goods delivery and agricultural monitoring. NASA Ames, in collaboration with industry and academia, has been pursuing the development of the UAS Traffic Management System. I believe this is a strong path forward in bringing together many of the features of air traffic control to ensure safe and efficient drone operation. However, there is still tremendous research to be done in terms of security, resource allocation, and contingency management.

When flying in the same airspace as manned aircraft, a "sense and avoid" system is likely to be necessary to help prevent collision. The FAA has successfully flight tested a version of ACAS X on a Predator B aircraft. The Predator B is equipped with much more sophisticated surveillance systems and avionics than can be placed on smaller, far less expensive drones. It is likely, however, that much of the technology can be adapted for sensor systems that are appropriate for smaller drones. I anticipate that sense and avoid technology will progress significantly over the next few years. Estimating the reduction of risk with such sense and avoid systems can be done through modeling and simulation.

In conclusion, I offer the following: The growing popularity of commercially available drones presents a risk that should not be ignored. Education should play a major role in risk reduction. In addition, there are technologies that can be easily implemented by drone manufacturers on the relevant categories of drones to help prevent inadvertent altitude or geographic airspace violations. It is in the interest of the drone industry as a whole to implement these safety measures. It is in the interest of our nation to support the research needed to ensure aviation safety as our technology evolves. The future of unmanned aviation is bright and has the potential to flourish into an entirely new industry with applications yet to be imagined.

Thank you for this opportunity, and I am happy to be a resource to this subcommittee.

October 30, 2015

Honorable Frank LoBiondo, Chairman
House Subcommittee on Aviation
2251 Rayburn House Office Building
Washington, DC 20515

Honorable Rick Larsen, Ranking Member
House Subcommittee on Aviation
2251 Rayburn House Office Building
Washington, DC 20515

Re: Unmanned Aircraft Systems Safety

Dear Mr. Chairman and Congressman Larsen:

On behalf of the Golden Gate Bridge, Highway and Transportation District (District), I am submitting this letter as written testimony for the record pursuant to the Subcommittee's hearing on October 7, 2015, entitled, "Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems". As the Subcommittee examines the nature and extent of safety issues posed by the growing use of unmanned aircraft systems (UAS) in the national airspace, the District offers its strong support for the regulation of both commercial and recreational UAS. In particular, we have grave concerns that the Federal Aviation Administration's (FAA) Proposed Rule, *Operation and Certification of Small Unmanned Aircraft Systems,* does not go far enough to ensure that critical infrastructure, such as the Golden Gate Bridge, is protected from the inappropriate, hazardous, or potentially destabilizing effects that may result from misuse of the technology. While we understand that Congress has directed the FAA to promulgate rules concerning only the non-recreational or non-hobby uses of small UAS, we encourage Congress to also request that the FAA extend its regulatory reach to the personal use of UAS and their inherent safety and security risks. Accordingly, our comments are directed not only at the limited scope of the FAA's Proposed Rule, but also on the larger safety concerns arising from the operation of small hobby UAS near the Golden Gate Bridge.

The District is a California Special District created by the Legislature in 1923, pursuant to the California's Bridge and Highway District Act, as amended. (See Cal. Streets & Highways Code Section 27000 *et seq.*) The District is governed by a 19-member board, composed of members representing the City and County of San Francisco, Marin County, Sonoma County, Napa County, Mendocino County, and Del Norte County. It owns, operates, and maintains the Golden Gate Bridge as well as a fleet of buses and ferryboats dedicated to providing regional public transportation service. The mission of the District is to provide safe and reliable operation, maintenance, and enhancement of the Golden Gate Bridge and to provide transportation services for customers within the Highway 101 Golden Gate Corridor.

The U.S. Department of Homeland Security defines "critical infrastructure" as that which is "so vital to the United States that the incapacity or destruction . . . would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters." (42 U.S.C. § 5195c, subdiv. (e).) As such, and as an international icon, the

District has implemented numerous safety and security protocols necessary for the protection of the Bridge, including, but not limited to, restricting access to certain areas both on and near the Bridge, prohibiting the commercial use or public dissemination of images taken in non-public areas, and additional general safety precautions on the roadway and sidewalks. Despite current protections, these protocols could be compromised through the use of UAS.

The District strongly supports the FAA's efforts to regulate the use of UAS and feels that this is a positive step forward addressing safety concerns raised by this burgeoning technology; however, the District asserts that facets of the regulation should be extended to non-commercial operators as they pose similar risks. Small UAS are an exciting technology with many commercial, industrial and recreational applications, including those which are of interest and applicability to the District, and are currently utilized by the District, to facilitate the inspection of parts of the Bridge where visual access is difficult. However, the rapid increase in the presence of these UAS flying in the immediate vicinity of the Golden Gate Bridge raises significant safety and security concerns about both the intentional and accidental risks related to UAS operation near a heavily trafficked bridge. These concerns range from the need to protect highly sensitive security information that could be captured on camera by a small UAS flying in areas generally restricted to the public and used maliciously, to the need to protect the physical safety of vehicles, pedestrians, and bicyclists that could be harmed by malfunctioning or distracting equipment hovering near the Golden Gate Bridge roadway and sidewalks.

In recent months the District has seen numerous UAS in various forms near the Golden Gate Bridge, including commercial multi-copters, flying wing aircraft that carry high resolution video equipment, and small inexpensive quad copter aircraft. These UAS have been witnessed flying in restricted areas, such as behind security fences, beyond intrusion detection sensors, and near the Golden Gate Bridge towers. Although we are unable to confirm their origin, the District believes that the majority of these UAS are flown by hobbyists rather than commercial operators. If the District discovered an individual with a camera in any of these areas, they would be cited and arrested immediately. To properly address this loophole, the District asserts that the FAA's proposed rulemaking should include a provision allowing operators of UAS in these areas to be similarly cited.

Moreover, because UAS often display no markings, it is virtually impossible to identify their operators, to determine whether the UAS is operated commercially or recreationally, to understand the motive or reason for the flight, and/or to implement the necessary security protocols. Ultimately, the District has no way of knowing whether security sensitive information is photographed or filmed let alone if the footage is used commercially (and subject to the Proposed Rule) or for other more nefarious purposes. Specifically, we are extremely concerned that UAS might be used to access design and engineering information or to determine security staffing levels that, if in the wrong hands, could become a threat to the safety of the Golden Gate Bridge as well as the larger Golden Gate corridor. If left unregulated, this new technology has the potential to undermine the District's extensive safety and security measures that have served to protect the valuable asset and the thousands of individuals who depend upon our vital transportation link and iconic tourist attraction.

Further, the District is concerned with protecting the safety of its roadways, parking lots, and sidewalks. The Golden Gate Bridge was completed in 1937. As an older facility, its roadway lanes are 10 feet wide or less, and not the standard 12 feet wide of most highway lanes in California. It has a high volume of traffic and changing lane configurations depending on the time of day and traffic volumes. Vehicles move swiftly on the Bridge given our Automatic Electronic Tolling system, which has eliminated the need to stop at any toll booth. In this busy environment, we are frequently observing UAS flying directly over vehicles and near the toll plaza. In fact, a hobbyist UAS operator recently crashed an inexpensive quad copter aircraft on the Golden Gate Bridge roadway. While it was fortunate that the crash did not cause a major traffic or chain-reaction collision, it certainly could have. This incident underscores the significant safety concerns UAS pose when operating above or near the crowded Golden Gate Bridge roadway.

Finally, there is also a risk to the multitude of pedestrians and bicyclists who use the Golden Gate Bridge and other District property every day. Again, the Golden Gate Bridge is an older facility with narrow sidewalks that are used by thousands of pedestrians and bicyclists daily. Given the mixed use of these sidewalks, there is a great danger that low-flying UAS might strike or distract bicyclists or pedestrians and cause accidents among our visitors.

For these reasons, the District supports regulation requiring that:

- UAS be identifiable with specific markings;
- operators who fly UAS over public roadways be certified and vetted by the Transportation Security Administration to ensure they have adequate training and operational skills;
- operational limitations be imposed restricting UAS from security sensitive areas;
- use of the aircraft by persons with known physical or mental conditions that could interfere with their safe operation are prohibited; and,
- maximum airspeed and preflight inspection requirements are honored.

The question of whether the UAS are commercially or non-commercially operated should be the basis for determining whether minimum standards are imposed prior to allowing their use.

All untrained hobbyists should be limited to open spaces, parking lots, and other areas that do not pose an immediate threat to public safety. Those who are not professionally licensed, trained, certified, and insured, should be prohibited from flying over public roadways.

While the District strongly supports the FAA's Proposed Rule as it ensures that minimum standards are imposed upon commercial operators, we contend that the distinction between commercial and hobby or recreational use is often opaque. Therefore, we assert that these minimum standards should also apply to, and be expanded to include, non-commercial UAS operators. The District also requests that Congress continue to examine the growing national security risk posed by UAS operation in high-security areas, as we hope that ultimately, all UAS

are prohibited from operating in areas already restricted from the public as well as near areas of critical infrastructure, without prior formal authorization or approval.

We greatly appreciate the Subcommittee's efforts on this issue and thank you for holding this hearing. If we may provide any further information, please do not hesitate to contact me.

Sincerely,

Denis Mulligan

Denis J. Mulligan
General Manager

NAMIC®

NATIONAL ASSOCIATION OF MUTUAL INSURANCE COMPANIES

Statement

of the

National Association of Mutual Insurance Companies

to the

United States House of Representatives

Committee on Transportation and Infrastructure, Subcommittee on Aviation

Hearing on

Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems

2167 Rayburn House Office Building

October 7, 2015

Introduction

The National Association of Mutual Insurance Companies (NAMIC) is pleased to provide testimony on issues pertaining to ensuring aviation safety at a time when the use of unmanned aircraft systems (UAS) is increasing rapidly.

NAMIC is the largest and most diverse property/casualty trade association in the country, with 1,300 member companies including regional and local mutual insurance companies on main streets across America and many of the country's largest national insurers. NAMIC members serve more than 135 million auto, home and business policyholders, with more than $208 billion in premiums accounting for 48 percent of the automobile/homeowners market and 33 percent of the business insurance market.

This hearing is being held to enable the Subcommittee to better understand the nature and extent of potential risks posed by unmanned aircraft to aviation safety, how to measure and analyze possible risks, and what technological, educational and policy solutions should be used to mitigate such risks.

NAMIC has been a leader with respect to UAS risk and insurance related issues, submitting comments to the Federal Aviation Administration (FAA) on proposed UAS rules, publishing a white paper, testifying before Congress and developing the Compendium Of State Laws And Proposed Legislation Related To Unmanned Aerial Systems/Drones for the National Telecommunications and Information Administration (NTIA) Multi-Stakeholder Meeting on Privacy, Transparency, and Accountability Regarding Commercial and Private UAS.

The development of recreational and commercial uses for unmanned aircraft systems is accelerating. More and more individuals and industry sectors are contemplating the use of UAS, but regulations and laws in the U.S. have not kept up with that development. In fact, just last week the FAA said it is expecting as many as one million small UAS to be sold during the 2015 holiday season. Yet at present, instead of a regulatory scheme which defines and accommodates commercial or recreational use of UAS, there exists a system of regulation-through-exemptions, and across states and localities, a hodgepodge of restrictions that leave numerous supervisory gaps.

Regardless of the prudent mitigation measures undertaken by regulators and the UAS user community alike, accidents are unavoidable. Property/casualty insurers, with their ability to pool risk and insure liability stemming from such mishaps, will be critical to the rise of the use of UAS, as auto insurers were critical to rapid growth of the individual use of the automobile. But in order to properly assess risk, the property/casualty industry must first be able to evaluate parameters of safety. Unfortunately, the absence of a regulatory scheme has precluded both users of UAS and the property/casualty insurance industry from being able to properly and adequately gauge the level of safety associated with various applications of UAS. Therefore, insurers find it very difficult to accurately identify and price risk surrounding their use, hampering their ability to protect policyholders from potential liability.

NAMIC believes that the reasonable, effective, and efficient regulation of UAS is not only possible, but is necessary in order to clarify the parameters of safety, expose actual levels of risk, and offer proper protections from liability.

Underwriting UAS Policies

There are inherent risks in the operation of UASs, which will be amplified and exacerbated by the proliferation of their numbers, uses, and capabilities. The requisite combination of an aircraft, control hardware, control software, and a communication link – in addition to potentially hazardous payloads – makes risk assessment, management, and coverage extremely complex.

UAS insurance policies will contractually specify the extent and limitations of coverage, as well as exclusions, restrictions, and prohibitions. For most commercial coverages, policy terms are based on the work of underwriters evaluating the range of risks – their likelihood and severity – to adequately price and offer property and/or liability insurance. This information, however, does not exist for UASs. A November 2014 study of UAS liability and insurance in Europe – where commercial UAS use has been permitted for years – concluded that there is insufficient reliable data on UAS incidents or accidents available either in public form or from commercial sources, and that the lack of this information impedes the assessment of damage caused by UASs.

The extent of insurance coverage for recreational and commercial use of UASs in the United States is not very clear. While various internet sites purport to be, or link to, insurance companies that offer UAS insurance in various capacities, the actual coverage available is uncertain. It has been estimated that underwriters now insure only three percent of UAS applicants.

The standard commercial general liability policy that most businesses purchase covers bodily injury and property damage caused by an "occurrence," which it defines as "an accident, including continuous or repeated exposure to the same generally harmful conditions." As a rule, however, most, if not all, such commercial general liability policies have exclusions for damage caused by the operation of aircraft. Commercial property insurance policies also have various forms of aircraft exclusions, including policies that may specifically exclude coverage while a UAS is off the ground.

Most homeowners' insurance policies also exclude coverage for aircraft, with the exception of "model or hobby aircraft not used or designed to carry people or cargo." If a UAS has an attached camera or other equipment/payload, it may not be covered because the attachment may be considered cargo.

The only currently available insurance for UAS commercial operators may be specialized liability policies too complex or expensive for general use. Such coverage, if available, is generally written on an aircraft liability form meant to insure small piloted planes.

Legal and Operational Questions Surrounding Insurance Coverage for UAS

While it remains to be seen if any of these coverage options will prove viable as UAS use expands, another fundamental complication has been created by the lag between innovation and

regulation which could undermine virtually any UAS insurance policy. The FAA currently restricts the commercial use of UASs, but the breadth of the interpretation of the term "commercial" is very broad. The FAA position is that a farmer using a UAS to look at his own garden is a recreational user, but that same farmer using a UAS to view crops he intends to sell is a commercial user.

The FAA has also taken the position that reckless recreational UAS use is a violation of FAA rules. Property/casualty insurance policies – commercial or otherwise –often include a criminal act exclusion that excludes coverage for bodily injury caused by, or reasonably expected to result from, a criminal act or omission of the insured. The criminal act exclusion generally applies regardless of whether the insured person is actually charged with or convicted of a crime, and may include a criminal act committed by or at the direction of any insured. There are also state statutes that prohibit insurance payment for illegal activities. As such, until regulations have been established, any commercial use by any company that has not received an exemption from FAA may, in theory, be uninsurable.

1. Damage to or by the UAS

In making decisions concerning underwriting UAS risks and paying claims related to UASs, it will be critical to understand the application of the specific torts, as well as state and federal laws that could permit UAS use and/or generate lawsuits or fines against a UAS operator. To illustrate the complexity of insuring a UAS, consider automotive insurance coverage. Insurers consider the manufacturer, model, and value of the vehicle as well as the operator's gender, age, driving record, and other factors. Accepted underwriting standards are considered, with relevant minimum and state regulatory coverage requirements, to determine how to price and provide a policy. With UASs, the relevant pools are too small, and the actuarial classes and policyholder risk matrices are not particularly relevant.

UAS insurance contracts may specify matters as simple as whether the UAS is insured both in the air and on the ground, and as complex as defining the permissible operations of the UAS covered under the policy. It has been said that UASs exist for missions that are "dull, dirty, or dangerous." Insuring a UAS includes understanding just how dirty and dangerous is the work for which the UAS will be used and how the operations will be conducted to minimize unknown and unacceptable risk. For example, the price of a policy covering an FAA-certified pilot taking pictures with a UAS over a wheat field would likely be different that one insuring Uncle Ernie spotting bluefish at a populated ocean resort.

When a UAS crashes or is lost, any responsibility for the loss by the manufacturer or software provider will be more difficult, if not impossible, to establish. The legal and practical ability of an insurer to pursue reimbursements for UAS manufacturer defects or product liability is murky. It can be complicated by the possibility of damage to the system resulting from a failure.
In considering UAS coverage, there is also an interesting and unresolved question of UASs and local rights of land owners to prevent or impede UASs from being on, over, or near their property. Deer Trail, Colo., decided not to offer hunting licenses for shooting down UASs that might fly into the hamlet's airspace, but local interpretations of the extent of property owners'

rights to take action against UAS operators for trespass, invasion of privacy, and nuisance may impact the physical risk to UAS loss or damage and therefore insurance risk.

2. Regulatory Liability

With respect to recreational UAS use, the FAA's authority to "take enforcement action against anyone who operates a UAS or model aircraft in a careless or reckless manner" was affirmed in November 2014 by the National Transportation Safety Board. The NTSB directed an administrative law judge to decide whether the aircraft was operated carelessly or recklessly, but confirmed the authority of the FAA to issue an assessment order and fine the operator $10,000 for reckless operation of an unmanned aircraft.

The FAA has proposed regulations for small UASs, but it maintains that all other commercial UAS operations are not in a regulatory "gray area" and that the FAA "is responsible for the safety of U.S. airspace from the ground up." The FAA asserts that it has a number of enforcement tools available, including a verbal warning, a warning letter, and an order to stop the operation. The FAA has reportedly looked for companies offering commercial UAS services and warned them to stop doing so, in some cases threatening "enforcement action."

Recall, however, that the FAA determination and definition of commercial vs. hobby UAS use are through a Notice of Interpretation with Request for Comment, rather than statute or regulations that the FAA is still drafting. There are many issues concerning UAS use and FAA authority that have not been codified in law or promulgated in federal regulations, raising numerous questions of the enforcement authority of the FAA in this regard and the impact of the notice on insurance coverage provisions.

3. Trespass and Privacy Liability Considerations

The Congressional Research Service has deemed privacy the most contentious UAS issue. Property/casualty insurance policies, particularly for commercial UASs, may include, or specifically exclude, coverage for and indemnification of tortious liability, including civil actions for trespass and privacy violations. Property lines are not always clear, and a shift of wind could inadvertently blow a UAS over a property line. These issues and the attendant liability and coverage depend highly on legal concepts of property and airspace that are evolving with UAS use.

Trespass in airspace requires the property owner to have possessory rights to the airspace allegedly violated by the UAS. To constitute an actionable trespass, an intrusion has to subtract from the owners use of the airspace above his property that he can actually use. With respect to privacy, there is no right to be alone in public nor is there any privacy invasion if a photograph is taken in a public place.

In 1587, matters were simple and clear under the common law: the owner of a piece of land also owned everything above and beneath it, *Cujus solum ejus est usque ad coelom* – from heaven to hell. Modern law has greatly muddied these legal waters. In 1946, the U.S. Supreme Court determined that Congress had declared a public right of transit in navigable airspace and national

sovereignty in that airspace. The court declined, however, to draw a clear line as to where that airspace began over a property. In the almost 70 years that have passed since that decision, that clear line remains undrawn.

Congress did declare a public right through "navigable airspace" and defined that space as the minimum safe operating altitude including airspace needed for takeoffs and landings. Now that many readily available UASs can take off and land on coffee tables, the forthcoming UAS regulations will require some official determination that FAA jurisdiction is either from the ground up or from some point in the air. This determination will not only be critical to define federal and state UAS jurisdictions, as well as personal rights, but will also directly impact liability of UAS operators for trespass, privacy issues, and cybersecurity.

An FAA designation of UAS navigable airspace will generally inhibit, if not preclude, allegations that a UAS in that airspace trespassed on private property or violated privacy. Should the FAA define UAS "navigable airspace" as "from the ground up," the FAA may practically eliminate private property limits – as well as state jurisdiction – on UASs.

4. Personal Injury/Property Damage

The law – through statute, regulation, or judicial decision – will generally seek to constrain and direct human action and social behavior by considering the risks posed to people and property, and the law has a long history of managing the risks of things falling out of the sky. Statutes and regulations will attempt to provide strict liability standards for certain injuries or damages from a UAS, but with rapidly evolving technology and very limited experience and expertise, there will undoubtedly be a wider range of practical and legal questions that will have to be addressed under common law claims, with judges making decisions on duty, breach, causation, and damages.

Then there is the concept of negligence per se, which results from the violation of a law meant to protect the public, such as a speed limit or building code. Unlike ordinary negligence, a plaintiff alleging negligence per se need not prove that a reasonable person should have acted differently – the conduct is automatically considered negligent – and the focus of a lawsuit will be whether it proximately caused damage to the plaintiff. Some courts may apply FAA interpretations and state regulations to establish negligence per se and some may not. In the most relevant example, one court may deem commercial UAS operation as negligence per se in violation of the FAA notice, while another court may require plaintiffs to prove duty, breach, causation, and damages.

Conclusion

When damage or injuries result from a UAS, a key question will be who is responsible and liable for damages. NAMIC member companies can provide comprehensive policyholder protection, but many serious questions about UAS regulations and civil liability will impede their ability to do so if gone unanswered. If the regulation of UAS and related civil liability remain unclear and incomplete, it will be very difficult for insurers to meet policyholder needs.

There will always be risks in the commercial use of UAS, and property/casualty insurance will be a critical consideration. The proposed FAA rules eliminate many of the more significant barriers for UAS insurance at the federal level, but practical and commercially viable responsible insurance coverage for this emerging area will require more development of federal, state, and local regulations, as well as related standards of liability, negligence, and property rights. As UAS regulations and civil liability standards evolve, NAMIC will work to ensure that these regulations provide the necessary clarity and breadth that its members need to provide policyholder protection.

We thank you for the opportunity to submit written testimony and look forward to working with the Chairman and members of the subcommittee in fostering a regulatory environment conducive to the proper identification of risk, a necessary precursor to adequate and appropriate liability protection.

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